



A Home for the House Martin

A study on how user-centred design can be used to create nature conservation solutions - demonstrated through the creation of a new artificial nest for the House Martin.

Master's thesis in Industrial Design Engineering

FOKKE VERBURGH

DEPARTMENT OF INDUSTRIAL AND MATERIALS SCIENCE

CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2025
www.chalmers.se

MASTER THESIS 2025

A Home for the House Martin

A study on how user-centred design can be used to create nature conservation solutions - demonstrated through the creation of a new artificial nest for the House Martin.

FOKKE VERBURGH



CHALMERS
UNIVERSITY OF TECHNOLOGY

Department of Industrial and Materials Science
CHALMERS UNIVERSITY OF TECHNOLOGY

Göteborg, Sweden 2025

A Home for the House Martin

A study on how user-centred design can be used to create nature conservation solutions - demonstrated through the creation of a new artificial nest for the House Martin.

FOKKE VERBURGH

Supervisor: Helena Strömberg

Examiner: Helena Strömberg

© FOKKE VERBURGH, 2025

Acknowledgements, dedications, and similar personal statements in this thesis, reflect the author's own views.

Master's Thesis 2025

Department of Industrial and Material Science

Chalmers University of Technology

SE-412 96 Göteborg Sweden

Telephone +46 (0)31-772 1000

Cover:

An AI generated image of a House Martin flying over a town in Sweden.

Cover by Fokke Verburgh, ©2025

Abstract

This study explores the implementation of user-centered design (UCD) through the development of an innovative artificial nest to support the conservation of the House Martin. This small bird species is currently experiencing a significant population decline in Sweden, as well as throughout Europe. Most of the existing artificial nests on the market often overlook the needs and preferences of human users; focusing solely on the nature, or in this case the birds, needing protection.

As a response this project aimed to design a solution that fosters both ecological and social benefits. Through an iterative design process, informed by extensive research and active user participation, key challenges such as material accessibility, ease of construction, and user engagement were addressed. A co-design workshop with industrial design professionals, along with feedback from diverse stakeholders—including House Martin experts and potential end-users—helped shape the nest design. The result was a cost-effective, inclusive solution made from widely available milk cartons.

By prioritizing the user's involvement and creating a product that balances practicality with ecological functionality, this project demonstrates how user-centered design can enhance the conservation effort surrounding the House Martin, as well as how public participation in protecting vulnerable species can be promoted.

Keywords: Nature conservation, user-centered design, artificial nest, House Martin.

Acknowledgements

I would like to express my sincerest gratitude to the people and institutions who have shared their expertises, encouragements and resources throughout this project.

First I would like to thank Naturskyddsföreningen for making my idea of designing a product for nature conservation a reality. Working on this project over the past six months has been extremely enjoyable, and I am excited to continue our collaboration to help the House Martins in Sweden.

I would also like to thank the industrial design agency Catino for their guidance and input throughout this project, as well as for inviting me to work at their creative space in Stockholm. And a special thanks to Jonatan Lundén and Daniel Amosy. It has truly been a pleasure.

Additionally I would like to thank my supervisor Helena Strömberg for her advice, guidance throughout this project, and always making the time for supervision.

Last but not least, I would like to thank all the users and experts who provided their feedback and insights in order to create a product that *really* helps the House Martins.

Fokke Verburgh

Table of contents

Introduction	1
1.1 Project Goal	1
1.2 Delimitations	1
Approach and process	3
2.1 What is user centered design?	3
2.2 The client	3
2.3 The overall process	3
Research	5
3.1 Research Strategy	5
3.2 The House Martin	5
3.3 People and Nature Conservation	12
3.4 Nest design	15
3.5 Conclusions	19
Design study	21
4.1 The process	21
4.2 Starting point	22
4.3 Ideas, Ideas, Ideas	22
4.4 Co-design workshop	27
4.5 (Almost) Everyone drinks milk	28
4.6 Simplicity is key	33
4.7 Perfecting the design	38
4.8 Testing the nest	43
4.9 Future outlook	47
Discussion	48
Conclusion	51
References	52
Appendix	55

Introduction

Over the past decades people have become more disconnected with the nature surrounding them (University of Oxford, 2023). This has resulted in a decrease in interest and willingness to participate in conservation efforts (Paterson, 2006). This is especially true for the Swedish Hussvåla, or House Martin in English. Since the year 2000 more than half of the population of House Martins has disappeared in Sweden, but this trend can be seen all throughout Europe (Staneva & Burfield, 2024). There are several reasons as to why the numbers have been decreasing so extremely. Partly because there is less food, being insects in the agricultural landscape, but largely due to the fact there are fewer suitable places for them to nest. House martins are one of the few species that depend on us humans with almost all of their nests located under people's roofs. The problem with the natural House Martin nests is the low tolerance of people towards them, often causing them to be taken down and destroyed (Kettel et al., 2021).

There are products aimed at aiding the House Martin conservation effort, mainly in the form of artificial nests that lower the risk of nesting failure due to natural causes, but these are often designed solely focusing on the nature in need of protection whilst overlooking the role of the user. When users aren't involved in the design process it could result in people that are less willing to participate in the conservation effort. To combat this, environmental incentive programs have been created that try to involve and attract participants through different methods, but most often by offering financial benefits. The problem with this method is that once the financial benefit is removed people often abandon the conservation effort altogether (Schenk et al., 2007). As more and more nature conservation efforts are required to save wildlife across the globe, a different method or approach should be used in order to create excitement and willingness to participate.

Despite artificial nests already being available on the market they don't seem to have created the intended awareness and tolerance towards the birds and their nests. Most of the current solutions are created for and targeted towards the nature needing protection, overlooking the needs of the people involved in realising it. These nests still mimic the clay-like structure that the birds would build themselves and as the natural nests are seen as a nuisance, hanging up artificial ones that look exactly the same doesn't seem to have solved the problem. This project is therefore looking to answer how people could become more inclined to participate in the nature conservation effort for the House Martin through the design of an artificial nest using a user-centred approach.

1.1 Project goal

The primary goal of this project is to explore how user centred design can be used to create a product that aids the nature conservation effort of the House Martin. This product, an artificial nest, should present a new direction and excite people to be part of a conservation effort. As merely deciding on a goal isn't enough to accomplish it, three research questions have been formulated that each pose a question to a relevant problem area. The questions are formulated as follows;

RQ1: How could user-centred design be applied to enhance nature conservation efforts?

RQ2: How can an artificial House Martin nest be designed to have a positive impact for both the birds and the people?

RQ3: How can the design spread awareness for the need of nature conservation?

1.2 Delimitations

This project is done over a timespan of twenty weeks, starting in September 2024 and ending in January 2025. In order to maximize the impact of the project some topics could not be covered during this time, these topics are:

- The potential ecological impacts of encouraging House Martins to use artificial nests in place of natural ones. Although relevant for the conservation effort there is already an existing market for artificial nests. Therefore this project aims to add an artificial nest design that offers a new direction within this market with a focus on improving user centeredness. This nest should be viewed as an addition rather than a replacement for the already existing nests.
- Due to the schedule in which this project finishes, around the end of January, the developed artificial nest is not able to be function tested with the House Martins themselves as they arrive in Sweden in April. Therefore the opinions of experts and users will be gathered to use their insights on how the solution could function. There is, however, the plan and possibility to test the nest with House Martins after the project has finished if the solution is well received by the users and experts.

Approach and process

To understand the approach and process of this study is to understand why certain choices are made. The information uncovered in this project will be used to create an artificial nest design from a new perspective and tested for its feasibility once completed. While most artificial nests on the market are designed with birds' needs in mind, I believe the requirements of the people using them have been overlooked or neglected.

Hence why this study will adopt a user-centered approach with the goal of creating excitement and acceptance from people towards the House Martin, and possibly nature conservation as a whole.

2.1 What is User Centered Design?

User-centered design (UCD) is an iterative process where the focus lies on the needs of the users in each phase of the project (Interaction Design Foundation - IxDF, 2016). Through this process a designer creates an understanding of the needs of the users, their preferences, and behaviours that aid in developing a product that meets their needs and expectations. Some people connect this method of designing with the Human-centered design process as all users are people. Unfortunately not all people will end up becoming users and therefore a more clear image of the selected user group requires to be created (Holst, n.d.). The UCD process is built up out of five major principles (Novoseltseva, n.d.).

1. The creation of a clear understanding of user and task requirements.
2. Incorporating user feedback to define requirements and design.
3. Early and active involvement of the user to evaluate the design of the product.

4. Integrating user-centred design with other development activities.
5. Iterative design proces.

By involving the users throughout the design process, designers can gain valuable insights, refine their ideas and concepts, and create a final product that truly resonates with their target audience (Plumb, 2023).

2.2 The Client

The idea behind this master thesis study came after a request from the Swedish nature conservation society – Naturskyddsföreningen – to design a new nest for the House Martin. According to them the last 20 years has seen a steady decline in the number of birds and the conservation effort requires more awareness and participating parties. They expressed the desire for a nest that people can build themselves or purchase. If the nest is built by people themselves they would like to present it on their website, together with the already existing nests instructions for other species of birds. What they currently offer for the House Martin is a link to a nest from another institution but what Naturskyddsföreningen desires is to have a design of their own that they can promote. The newly designed nest should be ready to be tested when the migrating House Martins arrive in Sweden in 2025. This will be around the beginning of April.

2.3 Overall process

The study follows the overall User Centered Design process, starting with a research study. As the goal is to create an artificial nest for the House Martin, a clear understanding of the birds was created before the users themselves were studied. Not every topic was easily researched through online sources and therefore a dialogue was started with expert users which has been used to generate more insights. This dialogue also allowed to incorporate their design feedback early on in the process whilst involving the users in the overall design process.

in the design process. The results from the research study has been used to formulate design requirements and early design direction.

The research is followed by a design study in which different directions are explored. This study will be built up out of multiple phases to have as many iterative design rounds as possible. The way these phases are structured allows for ideas to be quickly explored and evaluated. At the start of each phase the learnings from the last are taken and the design is either improved upon or used to develop a new concept. The user will be involved during each phase through concept presentations where they are asked to present feedback on the design, as well as share their overall thoughts. Based on their insights and other findings the ideas and concepts will be developed iteratively. The design study will end when a concrete artificial nest design has been formulated that meets the earlier proposed requirements as well as has received the support from users.

The results of the design study will be evaluated in the discussion where the design will be held against the earlier stated research goals, as well as the proposed design requirements. The overall process of the study will be reflected upon, as well as the ethical and sustainable impact of the proposed solution. The last part of the study will be a firm conclusion that will be able to be drawn on whether or not the design has fulfilled its intended purpose.

Research

This chapter starts with creating an understanding of the House Martin and why they need to be protected and conserved. Their decline will be mapped out in numbers, both in Sweden as well as in Europe, and the causations of the decline will be identified. Afterwards the connection between people and nature conservation will be examined and conclusions will be drawn in the form of demands and wishes for the design of the artificial nest.

3.1 Research strategy

The research study done for this project has been divided into three main topics; understanding the House Martins, understanding people's relationship with nature conservation, and understanding current nest designs. Varied methods were used to gather information and study their impact. Google scholar provided many studies on people's relationship with nature conservation through keywords such as People and nature conservation; Reluctance towards nature conservation; History of nature conservation; Disconnect to nature; Distance to nature; Wildlife, environment and society. By using keywords such as House Martins; Delichon Urbica, information on the House Martins was also provided but proved to be limited in availability. In order to gain enough insights that matter for the study online websites were accessed, mostly from conservation organizations such as the British Royal Society for the Protection of Birds (RSPB).

The House Martin is not a widely researched topic and much of the information online is repetitive in its message. User's experience with these birds are hard to find written about in articles or journals. Therefore blogs and Facebook groups have been consulted to gain more insights. The most important being the House Martin Conservation UK&Ireland Facebook group, made up of roughly 6000 members devoted to the

conservation effort of the House Martin. They are demographically varied and not all members are actually from the UK or Ireland. Outside of "regular" members the group also contains experts on the topic of House Martins. One of which, Claas Frankena from the Netherlands, has been particularly helpful with providing insights and feedback.

The collected information, insights, and feedback were gathered and analysed using the KJ method. This method is similar to affinity diagramming where large amounts of information or ideas are gathered before they are gathered into logical groups or categories. This method resulted in an organized overview of collected information that has been directly translated into findings for the research study.

3.2 The House Martin

The House Martin is a small bird with glossy blue-black wings and back with a distinct pure white underside that weighs no more than 18 grams. These little birds can't be found in Sweden all year round as they are a migrating species that cross the globe every year. When the winter is over, and the warm spring weather starts to settle in, they start their migration from the tropical rainforests in Africa towards Europe. They will arrive around April/May and make it their home until they migrate back in September/October, to do it all again next spring. While they are in Europe they spend much of their time in flight, eating airborne insects and finding a mate to pair with. Experts estimate that each House Martin eats roughly one full bucket of insects a year, which means that having them around a home leads to less mosquitoes, flies, and other insects that are often seen as a nuisance.

They also build their nests while they are visiting Europe. This process takes around 10 days (Vine House Farm, 2024) and the nests are usually located below the eaves of buildings. The birds build these nests out of mud in the shape of a

cup using around one thousand pellets of mud, each carefully collected using their beaks (RSPB, 2024). The House Martin is not a solitary bird and most of them prefer to live in colonies of up to 30 pairs. They also don't shy away from using a nest from previous years, or even a man-made, or artificial, nest which has been known to encourage colonies to form. Using artificial nests is beneficial for the birds as it saves them time and allows them to start brooding earlier in the season. Normally they have two broods where both the male and female incubate the eggs and feed their young with an average clutch size of four to five eggs (Vine House Farm, 2024).

In total there are currently an estimated 80,000 - 120,000 pairs of House Martins in Sweden, with a total of between 11,200,000 - 23,600,000 visiting Europe every spring (STANEVA & BURFIELD, 2024). There is quite a gap between the estimated numbers in Europe. The House Martin is known for living in smaller, dispersed, colonies that don't always return to the same location, or even country, every year. The knowledge on their numbers solely depends on people reporting House Martin sightings. As people's interest towards these birds has declined it has become harder for institutions to keep track of the size and health of the House Martin population.

Decline in numbers

The hardest part of mapping out the decline of House Martins is the lack of data. During the last global assessment of the number of House Martins there was no reason for concern "yet" (BirdLife International, 2017). Since then more and more people, experts, and associations have started to sound the alarm. Increasingly less House Martins are seen in their typical landscapes and countries and people are fearing that their decline is flying under the radar. When looking at the overall numbers from Birdlife international, an association built up out of 123 national Partners working to save the planet, nature and bird species all over the world, it can be concluded that there is an overall decline in the House Martin numbers. EU



Figure 1 - A House Martin feeding their young in a nest (Photo: Craig Richardson)

countries known for having large populations such as Poland (3% of Europe), Slovakia (4%) and Russia (8%) have seen an estimated decline as large as 30% since the year 2000 (Staneva & Burfield, 2024). Companies like IUCN Redlist, who are responsible for tracking the total number of House Martins worldwide and listing them as endangered when the number becomes too low, however, haven't acknowledged this decline yet (Burfield & Martin, 2021). As a reaction, individual associations have therefore started to ring the bell themselves.

A great example of how associations have taken matters in their own hands are the RSPB (the Royal Society for the Protection of Birds) and the BTO (the British Trust for Ornithology) in the UK. These national birds associations have monitored the House Martin numbers for decades and have tried and succeeded in creating more awareness of their decline. They have done this by involving more members of the public through initiatives such as the House Martin survey and The Breeding Bird survey (Heywood et al., 2023) which have created a better picture of the number of birds in the UK. What they discovered through these surveys is that since the year 1995 the number of House Martins have declined with 44% (BTO, 2022). This can be seen illustrated in figure 2.

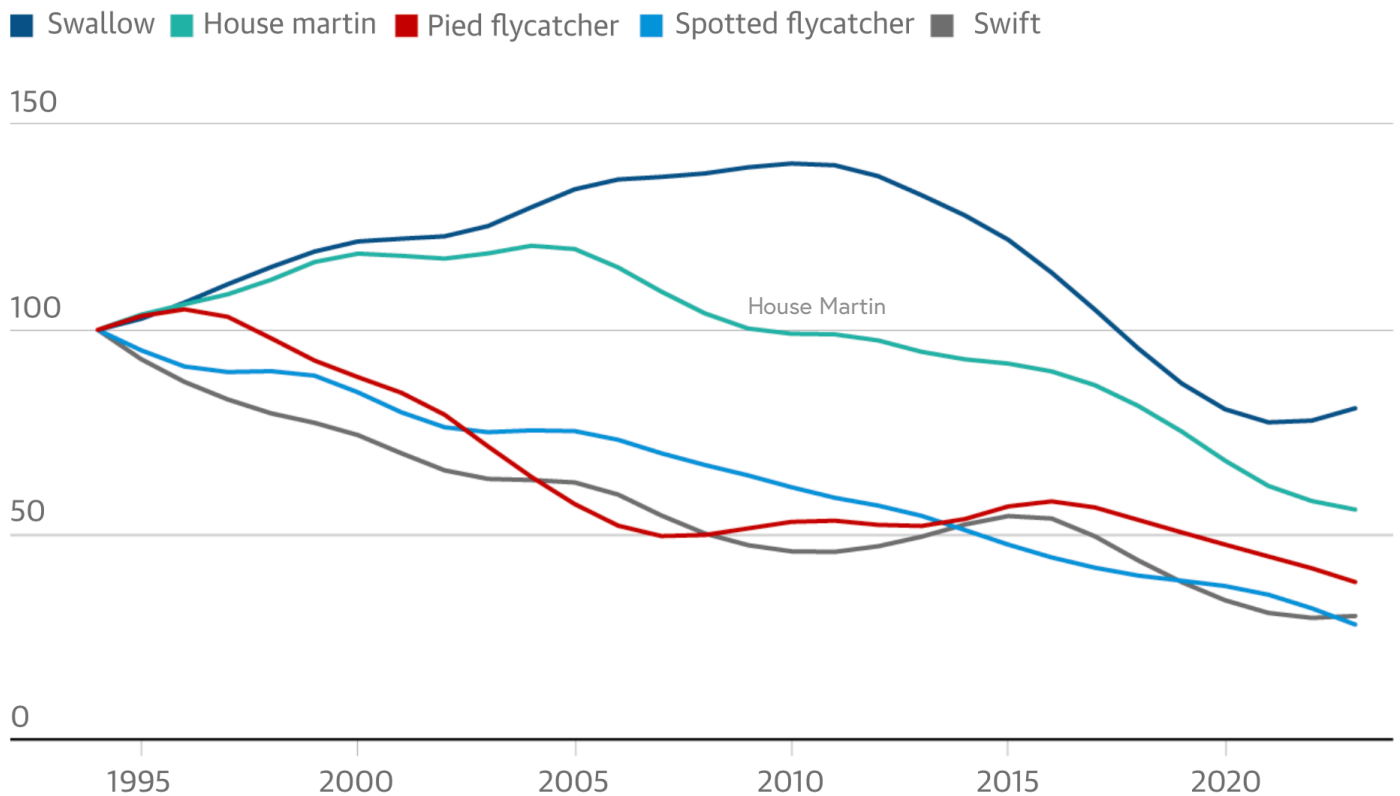


Figure 2 - Decline of House Martins and other swallow species in the UK (Graphic made by the Guardian (Weston, 2024). Source: British Trust for Ornithology)

As the Swedish association Naturskyddsföreningen has requested this project as part of their concern regarding the rapid decline of the House Martin it shows that similar concerns are present in Sweden. According to Birdlife International Sweden has seen an estimated decline of 15-39% (BirdLife International, 2017) but Swedish expert Niklas Aronsson, editor of *Vår Fågelvärld* (our Bird World) has predicted that the situation is actually much worse. They estimate that since the year 2000 more than half of the population has disappeared, whereas the last 10 years have seen the numbers decrease by 19% (Hansson, 2021). Local municipalities and associations have started to share Niklas' concern such as Närkes Ornithological society in Närke, located south of Stockholm. Their online survey through Artportalen, a service where people can report any sightings of certain bird species, has uncovered concerning results (Sveriges Lantbruksuniversitet, 2024).

Närkes Ornithological society inventoried its entire landscape for House Martins in the period 1974 - 1984 where the birds could be found nesting across their entire landscape. Safe nests were found in 187 Atlas squares, which have a size of 5x5 kilometres, with several nests found within the same squares. Meaning that there were well over 200 places where the House Martin nested in Närke. Corresponding inventories were carried out in the years 2005-2015. Safe nesting sites were then found in only 116 Atlas squares, a reduction of 38 percent (Haltunnen, 2024). Fast forward to 2024 and we are no longer speaking of nests in Atlas squares. Instead, only 9 individual nests were reported in Artportalen, where there were still 11 safe nesting sites in 2023. It can be concluded that there has been a large decline in the numbers of House Martins reported in Närke. This is mostly caused by the House Martin numbers not being what they used to be, but also the public losing interest in reporting sightings and therefore less information being available.

In an email conversation with an expert from Natursidan.se on the topic of the public being aware of the decline they provided the insight that most members of the public are actually surprised when they hear that there are not as many House Martins around as there used to be.

Reasons for the decline

The House Martin spends the majority of its life on two different continents. When the birds arrive in Europe they have already covered at least 10,000 - possibly as much as 20,000 kilometres (Heggøy, 2016). Not much is known about the challenges these birds face during their migration, but experts suggest that increasingly erratic weather patterns and frequent extreme weather events are leading to higher bird mortality rates. Similarly, little is understood about their time spent overwintering in Africa, as they typically stay high in the air. Climate change, however, has brought more drought to the region, which may reduce their invertebrate food supplies and cause the Sahara desert to expand. This would make the journey that the House Martins have to undergo longer and more difficult. Combined with limited access to food and water these factors could increase the likelihood of greater losses along the way (Pomroy, 2022).

Climate change is a worldwide issue that requires changes on a societal and governmental level. With a time limitation of 6 months, and this project focusing on a design solution, it won't be possible to create enough influence in the climate change debate. Luckily the factors become more tangible and influenceable when the House Martins arrive in Europe to nest and raise their broods. Many believe that it is impossible to determine what the one main driving force behind the House Martin's declining numbers is, but most reports seem to agree that the reduced insect availability, deteriorations of wintering grounds in southern Africa, increased predation and loss of suitable habitat are contributing to the overall decline in numbers (RaddaEnArt, 2021; Hansson, 2021; Kettel et al., 2021; Bengtsson, 2022).

Research shows that the loss of suitable habitat is a problem that can be divided into two topics. The first topic is directly impacted by the natural world surrounding them. House Martins build their nests by creating a "cup" using the clay they find in the landscape surrounding their chosen nesting location, often not travelling further than 200 metres from the nest they are building. Due to climate change it has become dryer and dryer in Sweden as well as throughout Europe (Felsche et al., 2024). This has made the wet clay that the birds use to build their nests more scarce. Nests that do succeed aren't guaranteed to stay up for the years to come. A survey done by Kettel et al. shows that nest failure is a common occurrence with the collapse of nests (32%) and eggs or young being taken from the nest by another species (26%) being the most common causations. Other reasons for nest failure were unknown damage to the nest (15%), eggs or chicks predated (11%), chicks or eggs thrown or fallen from the nest (10%) and wind damage (2%) (Kettel et al., 2021). As it takes a House Martin on average 10 days to build a nest it sets them back tremendously when a nest fails.

The second topic regards the last 4% of nest failures, and a major problem identified by experts; damage by humans, both intentional and unintentional (Pomroy, 2022; Hansson, 2021;). The way in which modern houses are built has caused major problems that are increasing the rate at which nests are failing. Houses used to be built using materials such as wood or stone which have much more texture for the House Martins to stick their nests to. With the arrival of modern, mostly synthetic, materials and building methods there are less places suitable for the nests. House Martins struggle to stick their nest to these new facades and most modern day houses have either no or very shallow eaves which excludes the House Martins from building their nests. If they do decide to try and build their nests on these types of houses they are often subjected to predation (Pomroy, 2022).

Human - Martin relationship

When the House Martins do find a desired nesting place they are often found, as their name suggests, around houses. This leaves them at the mercy of the house owner. Some people are excited to see these birds arrive for spring and are honoured to be able to house them for the next few months, but others see them as a nuisance and try to prevent the birds from nesting or take the nests down completely (Hannah, n.a). Even though this is illegal in Sweden, the UK, and many other European countries, it hasn't stopped this awful behaviour. A quick search on the internet finds many services offering House Martin nest removals, anti nesting products, and/or tips on how to prevent these birds from nesting on or around one's house. Illustrated in figure 3 and 4.

The preventative measures against the House Martin go further than products that are for sale. There are currently numerous blogs online where people try to consult one another on how to best remove the clay nests and how to make sure they don't come back. There are others present on these blogs that try to reason for the protection of the House Martins and their nests, explaining that any action taken against the wellbeing of the birds is an illegal act, they are met with

scepticism. Successful methods on how to best remove the nests are still shared and encouraged. Extracted comments from these blogs, shown in figure 5, paint a picture of how people view the House Martin as a nuisance and don't shy away from harming the birds.

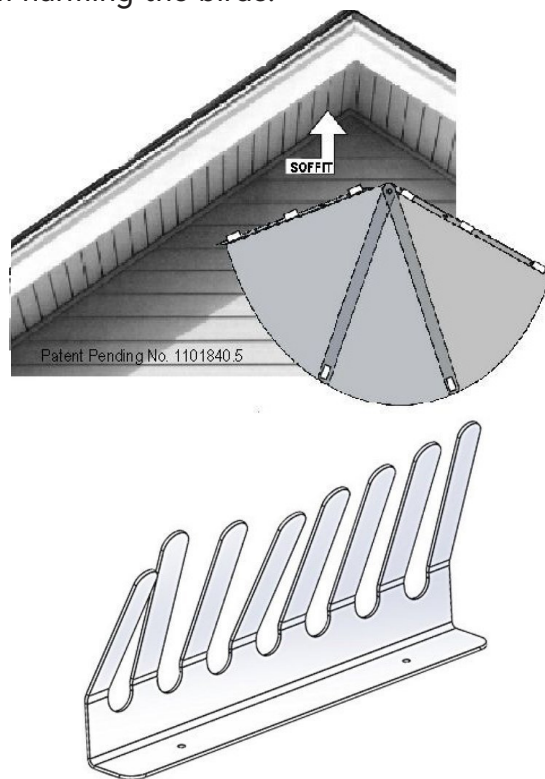


Figure 3 - Examples of the products aimed at preventing House Martins from nesting underneath eaves



Figure 4 - Recommended installation areas of anti House Martin products from the company Owlpestcontrol.ie. These are widely available on websites such as Ebay

These preventative measures are exactly the examples of the problem that the experts and research has been pointing towards and beg the question of; how many times does this happen every year when people don't communicate so openly about it.

How much of this information is shared and encouraged through word of mouth? But what could have triggered people to become so opposed to the nature surrounding them?

Does anyone know how to stop house martins from building their nests in my eaves? We've moved into a new house and when we looked round there was already a nest there and the mess was awful. There was poop all over the walls, windows and patio.

User 1

The nest had been removed and everything was cleaned up by the time we moved in. I don't want them to come back this year as I don't want all the mess and because I have a bird phobia. So I want to do something to prevent them from building before they start.

User 2

I used a few strands of shiny metallic curling ribbon, lightly curled, tied in the middle then wrapped a large lump of blu-tack round knot then dangling out of the window shoved it up onto eaves with bamboo cane. This deterred them from nesting. Our neighbours next door used drainage rods out of the bathroom window with carrier bags attached (removable), next door in the other direction used wind chimes (permanent fixture).

User 3

I had a house martins nest last year above my upstairs window that became infested with their bird mites which found their way into our bedroom and our bed. Previous to this I looked forward to the martins, now I am really desperate to prevent them from nesting too and have carrier bags up at all the windows.

User 4

We had a problem with house martins in our last house. We couldn't sit outside because we were in their flight path and the nest was right above the back door. I bought a wind chime and hung it from the eaves; a gentle breeze provided enough motion to deter them.

User 5

Figure 5 - Extracted comments from two different blog sites. The source, as well as the commenters have been kept anonymous as they are technically committing an illegal act by removing the nests

Just wondered if anyone had any idea how to prevent house martins nesting on your building. They built one last year just below our roof right above where we have our bench to sit out on (the only place we can put it), and the droppings were awful. This is driving my husband crazy so please help. They look like they're wanting to build one in the same place again and just wondered what might deter them.

User 6

Just prod them with a stick and they will drop off :)

User 8

We use chicken wire in between the roof and the top of the wall to stop the birdies getting into the eaves - definitely works.

User 9

As soon as the nest starts to appear, get the hose pipe or jet wash out & knock it down. Sounds cruel, but it worked for us a couple of years ago & they never came back. Try no to do it if the nest is established just in case there are eggs in there; but if you do it straight away they won't get a chance to lay any eggs.

User 10

When the house martins were abroad (winter time), I got a builder to remove the nests and put a net-covered frame up. He fixed it from the guttering to about a foot below it. This was 4 years ago and they've not been back since.

User 11

We certainly weren't planning to knock a nest down as are too nice to do that to the birdies. But it does look like we'll need to wait till the egg season is over so we can affix something as a preventative measure. Not sure about the plastic cover over the bench, think we'll just have to do without one for a while. We are happy for them to have their nest on our building, it's just that it's the worst possible place!

User 6

An elderly neighbour advised to get old rags soaked in paraffin and use them to stuff into any gaps where the house martins might have got in between the house wall and eaves. For where they just built the nest to the side of the house under the roof, use the rag soaked in paraffin and wipe off the old bird poo marks off the wall and soak that area in paraffin.

User 12

Figure 5 - Extracted comments from two different blog sites. The source, as well as the commenters have been kept anonymous as they are technically committing an illegal act by removing the nests

3.3 People and Nature Conservation

Not all people are happy to have the House Martin on, or near their home and some people have even gone as far as to encourage others to remove nests completely. The example of bloggers sharing solutions with each other highlights a long standing problem; people are not accepting of the nature around them and no longer view themselves as a part of a larger whole. Research suggests that there is a growing disconnect between people and the natural world surrounding them ((Wilson, 1984; Kahn Jr. et al., 2009; Paterson, 2006) which could continue to grow if no societal changes are made.

Disconnected

Research unanimously agrees that there is a disconnect present, but vary in their reason as to why it is happening. Wilson (1984) argued back in 1984 already that through the rise and development of technology, combined with a shift away from lifestyles dependent on the land, people's connection with nature has rapidly eroded (Pyle, 2003). Wilson's book was aimed at informing people of the dire end we are meeting if we do not change our behavior and hoped that in their future people and nature would become more connected. University of Oxford and Richardsson et al. have concluded as recently as 2023 that people are led further and further away through influences stemming from technological development. Innovations within technology aimed at bringing people and nature closer together through initiatives such as web cams that offer views of wildlife to robotic pets, might actually be doing the opposite (Live Science Staff, 2009). According to Peter Kahn, psychologist at the University of Washington modern technology is encroaching into human connections with the natural world which could emerge as one of the central psychological problems of our times (Kahn Jr. et al., 2009). Khan performed an experiment, together with two of his graduate students,

Rachel Severson and Jolina Ruckert, to look at the psychological differences between interacting with nature and technologically created nature. A great example of their findings are that people recovered better from low levels of stress by looking at real nature rather than the same real-time nature scene displayed on a plasma window (Live Science Staff, 2009).

Technological development, although encroaching on the health and wellbeing of both people and nature, is not all disadvantageous for the future of nature conservation. One major benefit provided by technology is that it has allowed researchers to monitor societal interest through their google searches. They were able to reveal that the public's interest in biodiversity has increased between 2013 and 2020, whilst at the same time the interest in actions to save nature declined over that same period (University of Oxford, 2023). Their research highlighted that the increase in interest was mostly caused by searches for characteristic wildlife and there was a substantial decrease in searches for conservation actions such as protected areas, habitat restoration, and eco-tourism. This aligns with the anthropocentric view presented by Paterson (2006) that people have adopted to the natural world surrounding them. Through this view nature is only worth saving if it has a direct benefit to humanity. This benefit could come from tourism, hunting, aesthetic value, etc.. The consequence of this anthropocentric view is that conservationists have to prove that a species is worth protecting because of its value to people; otherwise it risks the assumption that the species has no value at all (Paterson, 2006). This view proposes the question; *How can the value of having a House Martin around be presented as a benefit, and how could acceptance be gained for this belief?*

The Last Man on Earth

Though obviously disconnected, when people were confronted with the last man experiment it seems that they wish no harm be done to the

health of the natural world. The last man experiment is an ethical dilemma where people are asked to imagine that they are the last person on earth equipped with the means to eliminate all life on the planet. Would it be wrong to do so if there were no consequences? What happens when you ask yourself these questions? Sylvan (1998) suggests that most of society will argue that it would be wrong even though it can be done without consequences (Paterson, 2006). This thought experiment suggests that there is a believed value in species regardless of whether they have a value for humans. So if there is a believed value during the experiment, and people do not wish to see harm to life on the planet, *why is it so hard to create more acceptance and awareness towards nature conservation?*

Creating acceptance

It might have to do with how acceptance has been created in the past, and how this acceptance hasn't been sustainable over time. Schenk et al. (2007) has explored the factors influencing the acceptance of nature conservation measures in Switzerland. With their paper they aimed to gain new and deeper insights into the acceptance of nature conservation measures as no definite theory of acceptance had been available.

What Schenk et al. discovered was that, in contrast to what many people assume, economic factors aren't the most important to increase acceptance and often only creates acceptance on a superficial level. According to the authors the best strategy to create long-lasting acceptance of a nature conservation product would be a combination of how a solution is communicated combined with different forms of cooperation with the end users. They argue that people who have had the chance to cooperate in the planning and implementation process obtain deeper insights into the measures they are asked to use. These deeper insights then result in people understanding why they are asked to take these actions to change their behavior. Even though their study showed that cooperation and

communication are important for the acceptance of nature conservation measures, they found surprisingly few cases where people were actually invited to cooperate.

In the case of the House Martin, not many people seem to be aware of the problems surrounding the birds, highlighted through an email conversation with a Swedish expert on House Martins from Natursidan.se. They highlighted that people didn't think there was a rapid decline in the number of House Martins in Sweden, and reacted surprised when told, hinting at a disconnect which could lead to further deterioration. A possible solution for this disconnect could be to implement Schenk et al.'s idea on how to create lasting acceptance by creating better communication and cooperation initiatives. *Would giving people the opportunity to be part of the design process create a sense of connection between them and the House Martins? What would happen when the nest is required to be assembled by the end users themselves?*

The IKEA effect

What *would* happen when people build a nest for the House Martin themselves? Would they be more connected to the little birds that will call people's homes theirs too? According to Norton et al. (2012) the answer would be yes. They performed a study on the effect of consumers building their own products and the subsequent connection and appreciation for them, the so-called "IKEA effect". What they discovered followed the research done by Festinger (1957) that demonstrated that the more effort people put into an action or activity, the more they come to value it. They suggest that a psychological process in which the work done directly translates to a person's affection towards the product requires one additional and important factor: the extent to which the result is seen as successful. This suggestion is based on a large body of literature which demonstrates a fundamental human need – "an ability to successfully produce desired outcomes in one's environment; one means by which people

accomplish this goal is by affecting and controlling objects and possessions" (Norton et al., 2012,). They conclude that it is likely that when users build products themselves it increases both thoughts about the positive attributes and positive affect of the product, as well as create a larger emotional attachment.

The impact of external influences

Other factors than the previously mentioned are also relevant in explaining the disconnect, and subsequently how to re-connect people with nature conservation efforts. Richardsson et al. would argue that the disconnect between humanity and nature conservation isn't only caused by the choices people themselves make. Outside of prioritizing technology over nature, or solely accepting nature when there are direct benefits present, there are also other factors that influence the ability of people to be connected to nature. These factors are determined by a person's surrounding environment and subsequent abilities.

Engaging and connecting with nature through activities involving one's physical senses of sight, sound, smell and touch appear to be key factors to move people towards a better engagement with nature conservation behavior (Richardsson et al., 2020). According to Richardsson et al.'s study, engaging in simple nature activities emerged as the largest contributor to pro-nature conservation behavior, but what happens when these activities aren't accessible to all? Research from the University of Oxford has shown that higher economic inequality was linked to lower interest in biodiversity and conservation. People with a lower purchasing power are associated with a decrease in interest towards nature conservation, resulting in them spending less time engaging in nature related activities. This inequality may be caused by people with higher income being more likely to have greater access to formal and informal education and information about the environment (University of Oxford,

2023). The results from Oxford varied a lot between countries, even when they were geographically located close to each other. According to professor Uri Roll it highlights that the attention to local socioeconomic contexts is essential when creating designs for nature conservation.

The importance of children

The last and possibly most important factor is the influence of a childhood connected with nature on the possible disconnection when they are adults. Researchers from the Cornell University discovered that when children under the age of 11 spend time in nature, using their primary senses when doing activities such as hiking, camping, or fishing for example, they grow up into adults who care more about the natural world than those who didn't have those experiences (SUTTIE, 2016). This is further validated by a study done by Frantz & Mayer (2014) where they measured the connection to nature of children aged between 9-10 and 11-13 using the Inclusion of the Self in Nature Scale (INS) while they followed them through a four-day environmental education program focused on water. When they measured the children according to the INS again after the program ended, they discovered that the education program increased INS in both age groups compared to a group of same-aged children who didn't follow the program. The researchers highlighted activities where kids become truly immersed in the nature or story told, as critical to the effects and results.

The importance of nature exposed children can not be understated but it often depends on their parents or other adults to take the initiative to seek out nature related activities. As Pyle & VanderMaten (n.d.) mentioned in their research "People who care, may make choices to conserve; but people who don't know, don't even care. What is the extinction of a condor or an albatross to a child who has never known a wren?" and highlights that if adults or institutions don't take the initiative to teach children from a young age about basic nature or the nature surrounding them, showing them how to respect their role in

the environment, that it can lead to adults becoming disconnected from the natural world. According to Richard Louv (2008) many children today are suffering from what they call "nature deficit disorder" because they spend far too little time in nature. They claim this especially true for children in cities, where the access to green spaces is limited which has an impact on both their health and wellbeing and could impact their compassion towards the environment (SUTTIE, 2016). This is further corroborated by previous research demonstrating that the time spent in nature as a child engaged in unstructured active play—interacting with sticks, leaves, pebbles, etc.—has a large influence to the extent that they will be engaging in pro-environmental behaviour as an adult (Richardsson et al., 2020)

3.4 Nest design

The House Martins are apt at creating their own nests, but these nests aren't foolproof and an estimated 32% would fail before the nesting

season is over (Kettel et al., 2021). But what causes these nests to fail and what characteristics make these nests specifically House Martin nests? This chapter creates an understanding of the (design) requirements that make up a natural nest and analyses the already existing artificial nest market.

The House Martin as designer

These nests take around ten days to build and once finished they will start laying their eggs and brooding them out (Kettel et al., 2021). They are also known to prefer existing nests from previous years, repairing them if necessary, which makes them more likely to raise two broods (BTO, 2022). Figure 6 shows a natural House Martin nest with the characteristics highlighted that make these nests so suited for these birds.

- A. The opening of the nest is made by the House Martins to be as small as possible to allow only them to crawl in but to keep predators

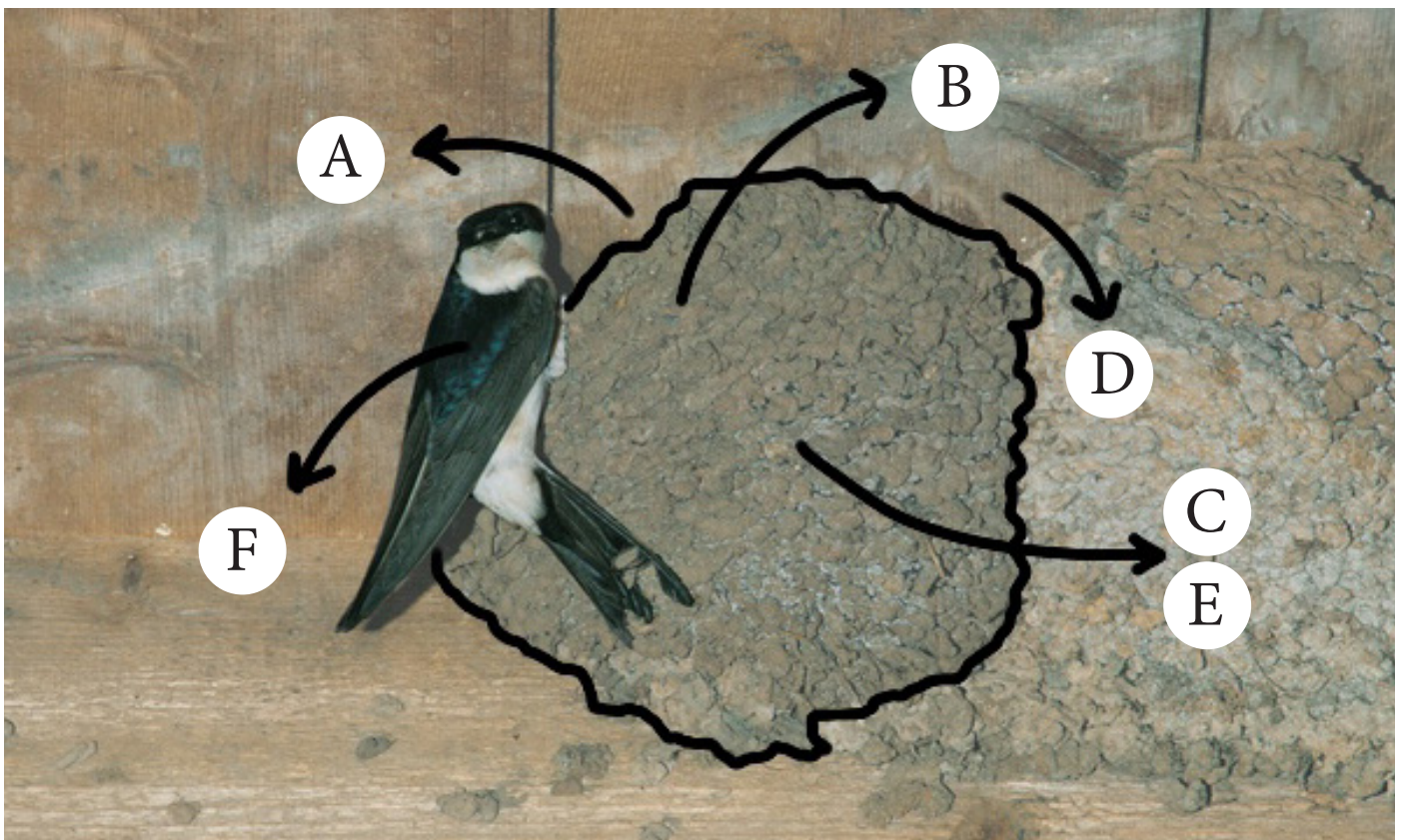


Figure 6 - A House Martin nest with all important design details highlighted

out. This is also done to prevent other birds such as sparrows or swifts from taking over the nest or claiming the nest the next season. With the help and information provided by the House Martin Conservation UK & Ireland Facebook group it can be said that the opening for a House Martin nest should either be 25 by 35 mm or 60 by 20 mm.

- B. The opening of the nest is placed further forward in the nest, as well as higher up than the "brooding chamber". This allows for the House Martin to be protected and out of reach from any potential predators.
- C. The overall size of the nest should accommodate a family of House Martins as they stay in the nest whilst brooding and sleep in the nests during the nights. Natural House martin nests size is roughly 80mm deep, 100-110 mm wide, and 60-100mm high. There are slight variations in the shape of the nest but they are always cup-like.
- D. The placement of the nests is always underneath eaves or other overhang structure of a house. They build their nests against the walls and these walls often have some sort of structure that allows for the clay nesting material to stick.
- E. The material used to build these nests, being mud and clay, is strong enough to protect the birds from the elements up to a certain extent.
- F. The House Martin builds its nest with as little gaps present as possible. These gaps host and incubate parasites that will affect that season's brood and could affect broods in the nest for years to come.

The design of the natural nest isn't foolproof however. Each year there are a plethora of nests that fail. Previously in this paper a study was mentioned by Kettel et al. (2021). They discovered that nest failure takes place to around 32% of nests yearly. Even with the opening far away from the nesting chamber the eggs or young being usurped by another species accounted for 26% of the nesting failures. Other relevant statistics were the damage to the nest accounting for 15%

and wind damage at 2%. The nests being made out of mud and clay has also brought problems to the House Martins as many people aren't accepting of having these nests in their homes or sheds. A colony of birds can also cause a lot of uncleanliness with them pooping right out of the nest. With the natural nests being placed where it suits the House Martin best it could be in a very undesired position for the people owning the building.

People as designers

One of the reasons for the House Martin decline is the lack of suitable nesting places. The traditional sites such as barns, houses, or other buildings with textured walls, have declined greatly. With many houses switching to PVC or other plastic materials, and suitable houses not always accepting of the natural nest, there is no longer the same offering of opportunity for the birds to create their nests as there used to be (BTO, 2022). As a solution bird and nature enthusiasts across Europe have developed artificial nests to aid the birds. The market is divided twofold in both pre-made nests for purchase and nests that can be made by people at home. Figure 7 shows an artificial nest design that is most commonly available for purchase with the unique elements highlighted.

- A. It is clear at first glance that the nest mimics the natural nest as closely as possible. It has maintained the recognizable cup shape and appears the same size.
- B. The nesting material used for the majority of the nests on the market is either woodstone or another cement like material. These allows for the same appearance as the natural nests, with the birds using clay and mud, but greatly improves on the strength. This material is hard enough to deter predators and with the nest hung up properly it will protect the birds from the elements for many seasons.
- C. The dimensions of the opening of the nest are proven to work, with most nests opting for a 20 by 50 mm opening.

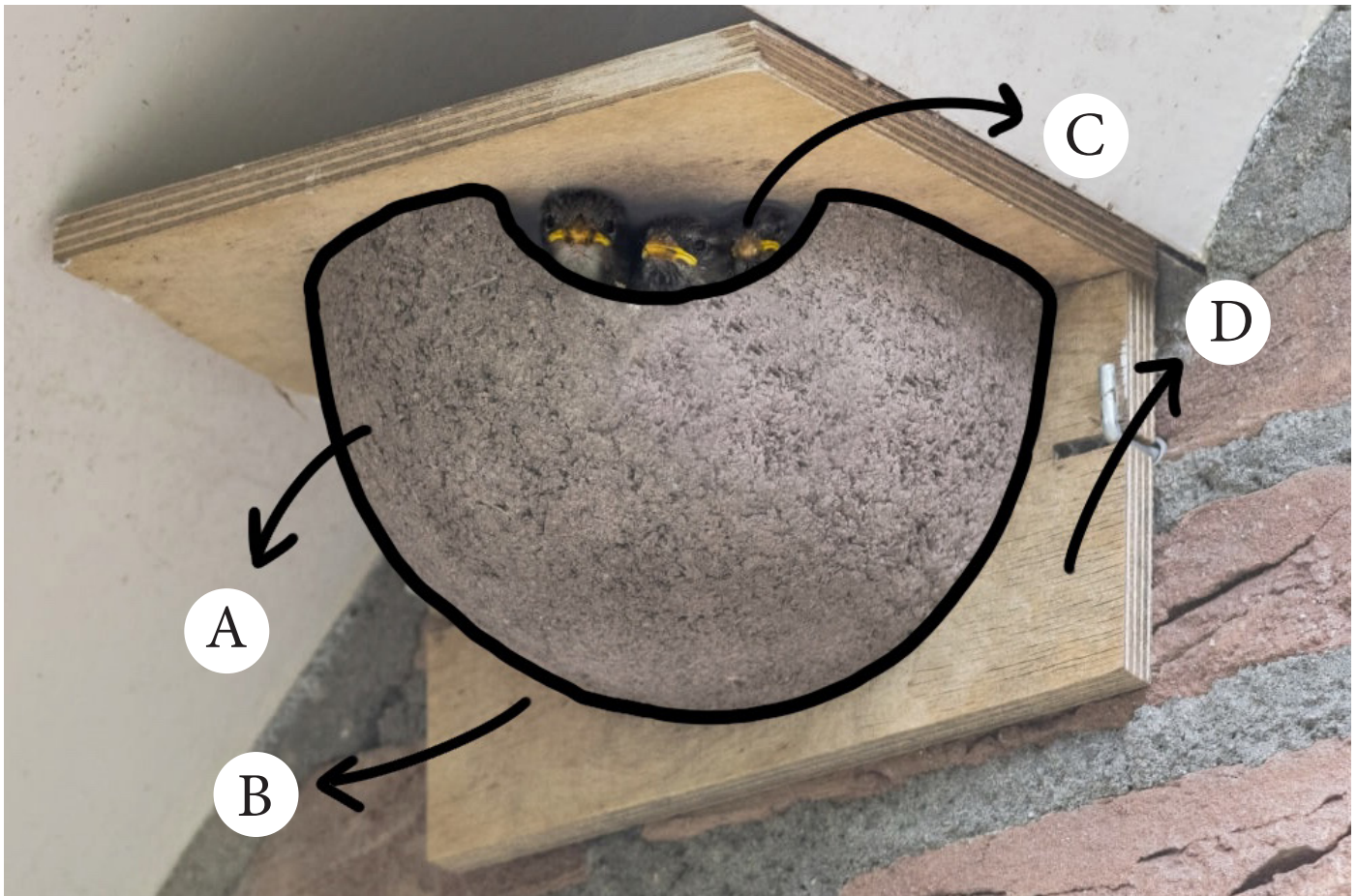


Figure 7 - The most common artificial House Martin nest design with all important design details highlighted

D. The nests are often attached to a ply wooden backing covering the top of the nest and making it easier for users to hang it on their walls.

The drawback for this type of nest is that they are heavy. With the nest needing to be hung up on a wall at least 2 meters high, there is almost always a ladder required for the user to climb on to assemble the nest. A single artificial nest weighs between one and two kilograms and double nests weigh closer to 4 kilograms. This, combined with an awkward shape, could lead to nests not being hung up as the user doesn't deem it easy or safe to climb a ladder with a nest in hand, and then to try and assemble the nest needing two hands while standing high up. This behavioral threshold is something to be avoided when designing the new artificial nest as the conservation effort should be accessible to all.

The nests are not only heavy, they are also expensive. The market is divided in its pricing but the cheapest options for a single nest costs on average €25,- and a double nest €35,-. This price for a single nest could be acceptable for people motivated to aid the House Martin. The problem; House Martins nest in colonies with many nests side by side. The number of nests can vary per colony or location available but can quickly run up the costs. A financial example with the assumption that there should be a colony of six nests would mean that even with the cheapest options on the market a consumer will still pay between €105,- and €150,-. I believe that it can safely be assumed that not many people are willing to pay that much to hang up nests for the House Martins. Especially since there is no guarantee that after paying a lot of money that the nests will be used (van den Bremer & van Turnhout, 2024).

The DIY Market

To combat the high cost and make House Martin conservation more accessible people have started to create home made, or DIY (Do It Yourself), designs. As the name suggests these nests are able to be made by people at home at a relatively low cost. The most popular option is to use paper mache as seen in figure 8. People put the paper mache on top of a balloon, cut it in half and then use each halve for a nest. As paper mache is not water resistant by nature people treat the outside with a natural colored paint, followed by a coat of waterproof PVA glue (BBC Gardeners' World Magazine, 2019).

The problem with this design is the structural strength of the material. Many users worry that when a material isn't strong enough to deter predators that birds such as woodpeckers or jackdaws will be able to break open the nest and usurp the young. The paper mache material is also vulnerable to the elements, even with a waterproof coating. When the water inevitably makes contact with the paper mache it will start to wilt and lose its strength, leaving the birds vulnerable with the possibility that the nest will fall down.

A different DIY option is recommended by Naturskyddsforeningen on their website and shown in figure 9. For this design people are asked to use a felt or carpet material and plywood. By cutting the wood and felt material in a certain shape the user is then asked to permanently nail them together, and this structure can then be added onto the wall. This design is using materials that will already last much longer out in the elements than paper mache and has been proven to attract House Martins. After speaking with one user that has tried to create this nest by using the instructions provided they discovered, however, that the materials chosen were hard to source and it took them a couple of days before they had everything together. With materials hard to source it could become a threshold for people less motivated to aid the House Martins.



Figure 8 - A DIY House Martin nest made out of paper mache



Figure 9 - The DIY option as promoted by Naturskyddsforeningen

Other alternative options that can be found on the internet are shown in figure 10. These are not widely promoted or encouraged on forums but still interesting as they show that they are used by the House Martins. With little information known about them more insights were gathered by consulting the House Martin Conservation UK & Ireland Facebook group. They highlighted that although proven by the House Martins using the nests in the images, they could have been used after a nest had fallen down. They were fairly confident about this regarding the nests made out of the cardboard box, as well as the ice cream box. People couldn't confidently identify why the wooden box nest worked, but the creator claimed

that this nest was made with the intent of attracting House Martins and that it had been put up before the nesting season started. Judging by the amount of poop stuck to the wood it could be concluded that this nest has been in use for at least the duration of a season and possibly has even seen chicks grow up and fledge.

What these different DIY nest design options highlight is that although the artificial nests that are for sale mimic nature, there is room to play with the design of the nest with new possibilities that can lead to an increased acceptance of the birds.

3.5 Conclusion

The goal of the research done was to understand the House Martin as a species and how people are involved with nature. Through this user-centered view, combined with bird and nest specific knowledge, the following requirements have been drawn:

Technical design requirements:

- The opening needs to be 25 by 35 mm or 20 by 60 mm - In order for other species not to occupy the house martin nests the nest opening needs to be big enough to allow the HM to enter, but also too small for other species such as swifts and sparrows.
- The nest should be around 80mm deep, and 100-110 mm wide and 50-100mm high - The nest needs to create a feeling of safety for the House Martins, but also allow for multiple birds to be in the nest while brooding as well as offer enough safe space for the chicks to grow.
- The nest needs to be able to be hung under eaves - If the nest isn't hung underneath the eaves of a home or structure it will be rejected by the House Martins. These small and fragile birds have adapted to live close to people as predators don't dare to come as close to people, offering the House Martin



Figure 10 - Other DIY nests found on the market

the protection they require.

- The nest needs to be stable enough to support the House Martin and weather conditions - The largest impact on the House Martin numbers are nests falling down. The artificial solution should offer the security and protection where the natural nests can't, ensuring that the numbers of the House Martin can increase. The nest will be used for 2-3 broods per season and needs to be durable enough to last at least one, but preferably multiple seasons.
- The nest should mimic the natural nests where possible - Experts are of the opinion that artificial nests that mimic the natural mud cups work the best as a rejected nest won't do any good for the House Martins.
- The nests should have as little gaps as possible - Gaps hold on to natural materials and waste, allowing for parasites to cling to the nest and reproduce. This will harm the birds over time, and possibly do more harm as the seasons continue.
- The nest should be made out of the right material - Some materials won't protect the House Martin properly from the elements. Paper will soak and fall apart, fabric will allow the weather conditions to pass through and metal might make the nest so hot it will cook the chicks alive. Finding the right materials is of importance to the success and survival of the House Martin.
- The nest should be easily replicable - The House Martin lives in colonies and therefore multiple nests in close proximity are required in order for the House Martins to be interested and feel safe. If the nest is too complicated to build or takes too much time, it could become too much of an undertaking for people to stay interested in building them.

User-centered design requirements:

- The nest needs to be able to be built by people themselves - A feeling of ownership has pointed towards more acceptance of the House Martins and the possible mess they create. By building the nest themselves people might become more aware of the conservation efforts required, sharing the knowledge that is at risk to be forgotten, and spreading awareness through word of mouth.
- The nest should create the possibility to involve the youth - Involving the next generation has been proven to have positive effects on environmental opinions of the future. Children that have been exposed to nature from a young age are more likely to create nature aware adults.
- The threshold for participation should be low - If people are required to purchase a lot of items or spend a lot of time and effort in order to participate, the amount of participants could decline steeply. In order to attract as many people as possible the threshold should be kept low. This can be done through using simple methods of constructing, avoiding unnecessary or high costs, and avoiding tools that require prior knowledge and/or experiences.
- The nest should be accessible to all - There should be no discrimination between people of higher and lower wealth, class or descent.
- The nest should create the feeling of ownership and responsibility - creating a larger engagement with the users.

Design Study

The design process for creating a new artificial nest for the House Martin has been a largely iterative study. Through the development of many ideas, concepts and prototypes a final product has been realized that meets the needs of the users as well as the birds. Figure 11 shows an illustrated representation of the design process, where other parties were involved, and which tracks were considered – as well as abandoned.

4.1 The process

The process of this design study has been a largely iterative one. Figure 11 illustrates a process in which over one hundred ideas, sixty concepts, and numerous prototypes were generated. It started with a single idea to create a nest for the House Martin where people's demands and wishes would take priority in the hope to create a product that would encourage more people to participate in the conservation effort. The entire process has been divided into four segments; A, B, C, and D.

Segment is characterized by many and wide explorations on possible nest design directions. Inspiration was taken by DIY artificial nest designs for other bird species and a collection was created of visual references, products, and materials. This segment visualizes the process described in chapter 4.3

Segment B sees the most involvement of external stakeholders. A workshop was done with the Stockholm based industrial design engineering studio Catino, highlighted by the first arrow in figure 11. This workshop aimed to generate new ideas and resulted in a direction which showed much potential to continue with. The first artificial nest concept was also created during this segment and presented towards users and experts from the House Martin Conservation UK & Ireland Facebook group. This moment is marked by the second arrow in figure 11. They were chosen as

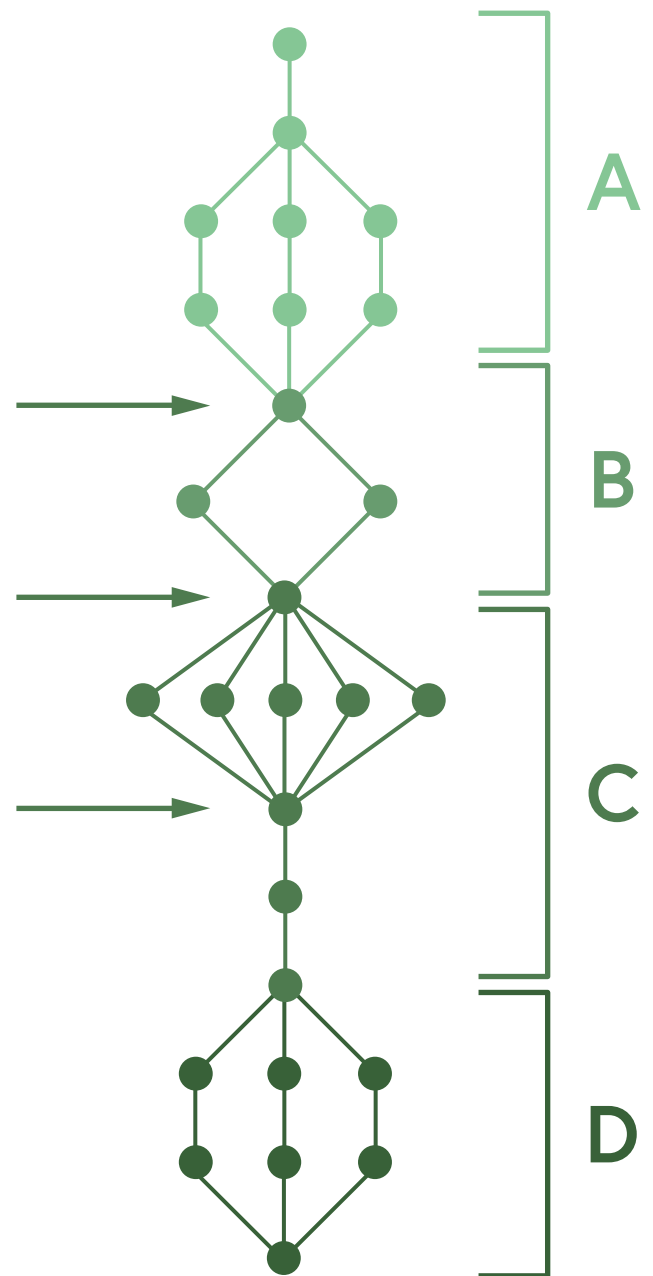


Figure 11 - Illustrated design process

the reviewing users as they, with their 6000 members, presented a varied demographic group of users with previous interest in the conservation of the House Martin. They would be able to provide both feedback on the design, as well as the impact it could have on the birds. Their feedback and input sums up this segment and highlights where further development was required.

This segment visualizes the process described in chapter 4.4 and 4.5.

Segment C spans the development from the first presented concept towards the final design and visualizes chapter 4.6 and 4.7. In this period the first user feedback required for more explorations to be done. Explorations in shape, building technique, user friendliness, and design aesthetic. What resulted from many iterations on both previous and new ideas was another nest concept. This design was once again presented towards the same 6000 users as before, marked by the third arrow in figure 11. Their feedback required the nest design to be further developed, but no longer provided the need to explore new directions. This segment ended with an artificial nest design that meets the requirements presented through the research done.

Segment D has been started during the design study and focuses on user testing. Especially the usability of the instructions that users are required to follow in order to build the artificial nest as intended. Both the design of the nest as well as the instructions will be changed and improved depending on their feedback. Due to the time constraints this segment could not be completed. It visualizes chapter 4.8 and 4.9 where the continuation is further described.

4.2 Starting point

The current artificial nest market is uniform in its appearance and function as the designs are trying to copy the natural nests as closely as possible whilst improving upon the natural clay material. Their goal is to increase the strength of the nests, ensuring that they won't fall down and offer maximum protection against predation. My goal as a designer is to combine these requirements with a solution that stands out from the current market, targeting the users and outgrowing the natural requirements. With nests made out of simple wooden boxes, plastic plant pots, and ice cream tubs all having been proven to work, I'm looking to challenge the philosophy that the

House Martins will solely use nests that are natural in appearance.

To create a solution that is truly user-centred it is imperative that actual users are involved in the design and decision making process. The problems surrounding the House Martin are larger than Sweden and are seen all over Europe. Therefore the decision has been made to try and involve as diverse of a user group as possible. Unfortunately this hasn't been able to be done through physical meetings and interactions. Rather, different online platforms have been used to gather user information. The user's feedback has been an important tool to measure the success of the acceptance, as well as understanding pain points. The proposed designs have received much critique and even though most feedback has been incorporated to improve the design, some decisions have been made to stick with design characteristics based on the experience gained through research and knowledge from a designers standpoint.

Industrial designers are no expert in the field of nature conservation, and especially not as specific as the conservation effort of the House Martin in Europe. Therefore experts have been found and recruited for this project to challenge insights and design decisions. These experts are spread throughout Europe and have many years of experience with House Martins and the creation of artificial nests. These expert reviews have been used to test the feasibility of the ideas created.

4.3 Ideas, Ideas, Ideas

For people not aware of the industrial design process it often starts with generating as many ideas and directions as possible. This method allows for a broad exploration and, combined with the earlier created demands, a good solution space can be selected.

The first design round resulted in the identification of three directions that the project could take.

Each direction shares as little characteristics with each other as possible to achieve a wide consideration of solution spaces. The main importance is that each direction still allows for some form of feeling of ownership from the user, as it is believed that that will create the best possible results in terms of involvement and willingness to participate in the conservation effort.

Direction one is inspired by the "generic" birdhouse with the box shape and wooden plank material whereas direction two aims to create a more organic shape using bendable materials, most likely thin plywood. Direction three is unique in the use of already existing products and/or waste materials.

Wooden birdhouses

The wooden birdhouse is the most familiar out of the three and a product that many people will picture when imagining a birdhouse, especially homemade ones. The material offers ample protection and there is freedom in its design by cutting wooden planks in different ways. With this direction being the most familiar it would create a lot of acceptance by the people. Many ideas were generated and figure 13 shows the final idea for this direction.

This exploration ended with a design that is still characterized with a box shape most often associated with birdhouses made out of planks. Other shapes could be possible but would require more skills from the user in order to create the nest correctly. Since the wooden box nest shown in the DIY chapter proved to attract House Martins it could be assumed that this nest would do the same. The main benefit for this design, as well as the material, is that the nest would be able to withstand the elements for several seasons as well as protect the birds from predators or nest usurpers. Other benefits are that it can be customized through the use of paint, and that it should be able to be extracted



Figure 12 - Three artificial nest design directions

from a single wooden plank. The design of the nest incorporates a "poop plank". As the chicks of the House Martins drop their feces out of the opening they often end up on people's windowsills or walkways. There is an increased risk for predation because of this plank though. Predators such as woodpeckers could wait for the House Martin to leave the nest by sitting underneath the opening using the plank.

This nest is not all positive though. In order to build the nest the user would be required to have some sort of woodworking tools such as a saw, nails, planks, etc., which aren't accessible to everyone and require space that might not be present in every home. The nest would also be heavy to hang up underneath an eave of a home and does still have somewhat of an awkward shape. The poop that is caught underneath the nest is beneficial as it no longer ends up on the

wall of peoples homes, but it does require to be cleaned out of the nesting box at the end of every season. If this isn't done it could lead to parasites living in the nest that could endanger the birds, as well as enter people's homes. Lastly, although there is an example of a wooden box housing House Martins, the expert users are still very sceptical of this not being a one time occurrence and are reluctant in ensuring that this type of product will work.

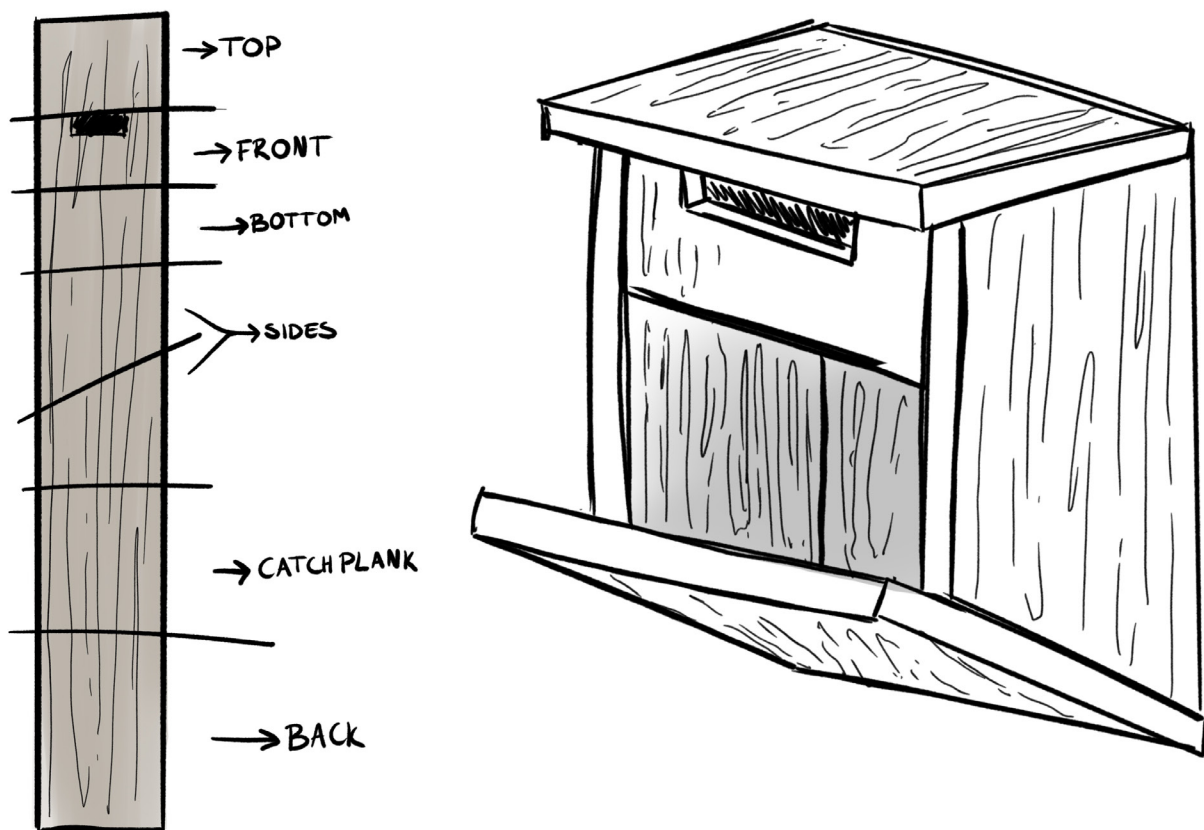


Figure 13 - Wooden birdhouse final reference drawing

Bent plywood

The second direction explores how thin plywood can be used to create an artificial nest that incorporates more form freedom. This material has been used for other bird house products and is well received by the users. Through the possibility to create expressive forms the material allows for a design that can be better tailored towards the user's aesthetic preferences.

This material has its drawbacks however. Since plywood is quite a thin material it will not last as long out in the elements as regular planks would. Although, if the plywood would be treated, it could prolong its lifespan. The idea is to present people with instructions on how to make the nest themselves. With the idea of bending the plywood it will require users to be more apt at working with their hands.

Plywood is also a different material than regular wooden planks and requires different tools that not everyone might have at home. This, together with thin plywood being harder to source, could present the user with too many thresholds and could stop them from making the effort to participate.

The other option is to create pre-cut shapes that the user assembles themselves at home. As the material is able to stay thin and low in weight, it allows for easy assembly as well as to be shipped flatpacked. This would eliminate the skills and tools needed for the user to create the parts. The drawback is that the user would be required to purchase the nests which, when produced in low quantities, might still be expensive.

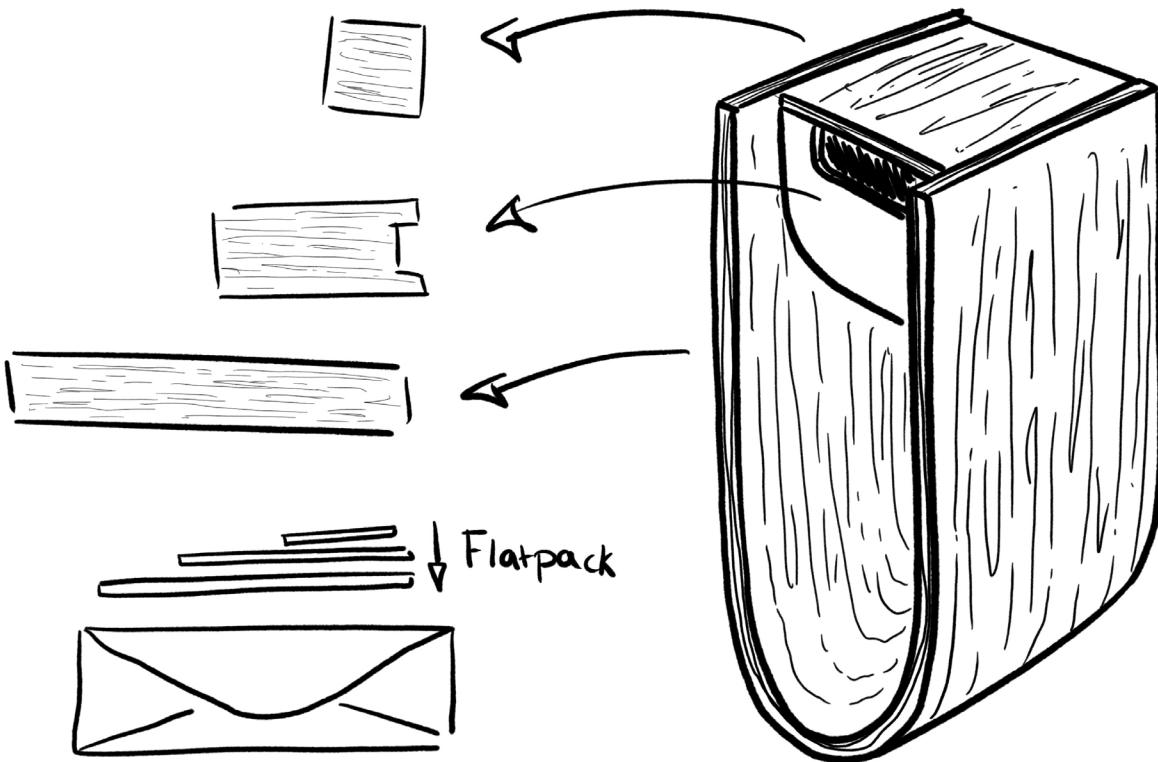


Figure 14 - Bent plywood birdhouse final reference drawing

Re-use of materials

The final direction was the exploration of what would happen when everyday objects or materials are used to create an artificial nest. The re-use of materials is a trend seen sparingly but provides an interesting take on what is required in order to produce a birdhouse. People have made nests out of plant pots, cans, PVC tubes, etc. with varying success. The benefit of creating a nest with materials that people have lying at home is that they aren't required to source new building materials themselves, and with a good design, household tools can be used to create the nest.

Removing the need for more advanced tools or knowledge means that the nest becomes much more accessible. Especially to people with less financial capabilities when a material that people already have at home is reused.

The idea is to re-use cans combined with a 3D printed front and further illustrated in figure 15. Using cans is promising as the cans have the right size and could house the birds. The material used to close up the front of the nest is in this case 3D printed. This, however, limits the design to people who have access to a 3D printer or are required to order the part online.

Although cheap and relatively accessible, this threshold could prove to be too high. This would limit the amount of willing participants. The other problem is that using cans, or even plant pots, could endanger the birds. Metal could get hot during the summer if the nest is hung in the wrong spot. Even though this idea of reusing material might not prove to work, it does function as the most accessible direction for the largest demographic of users.

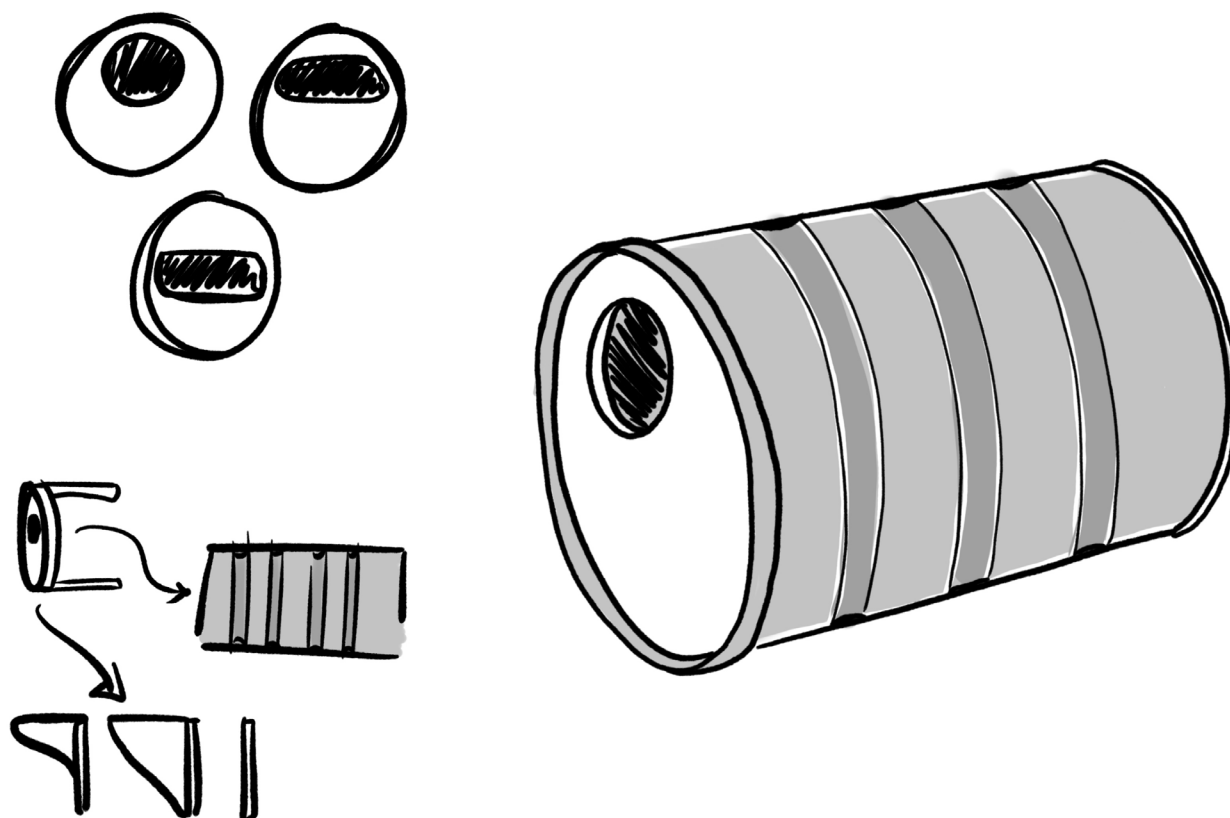


Figure 15 - Re-used material birdhouse final reference drawing

4.4 Co-design workshop

The first phase ended without a conclusive design to continue with. In order to gain new insights and inspiration a codesign workshop was arranged together with the Swedish industrial design agency Catino. With their expertise in smart engineering solutions it was a welcome addition to the design process for the artificial nest. Figure 17 shows a snapshot of the final result of this workshop.

The team at Catino were first presented with the background for this project and prompted with the idea "To create an artificial nest for the Hussvala that people can build themselves or buy, as well as to create more awareness of the conservation effort". Once they got a clear picture of the outline of the project the workshop got started. Through the collection of trigger words, ideas and moodboard images a collective idea

board was generated. Some ideas were fully fledged designs, as shown in figure 16, whereas others were quick line drawings that were pitched on the spot, and others were just single worded ideas. There were many good ideas generated but the majority fell off due to accessibility constraints or that they couldn't be made by people at home.

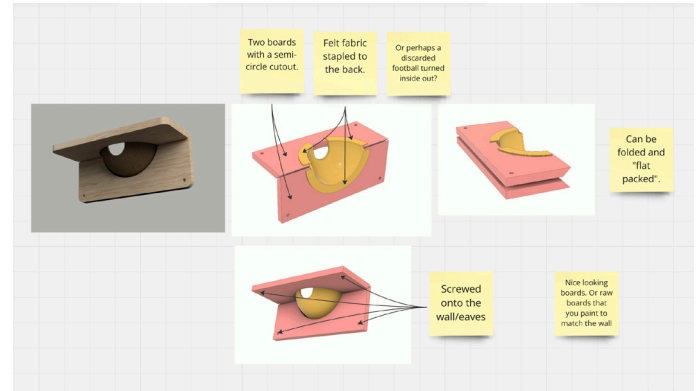


Figure 16 - A more tangible idea presented by Catino during the workshop

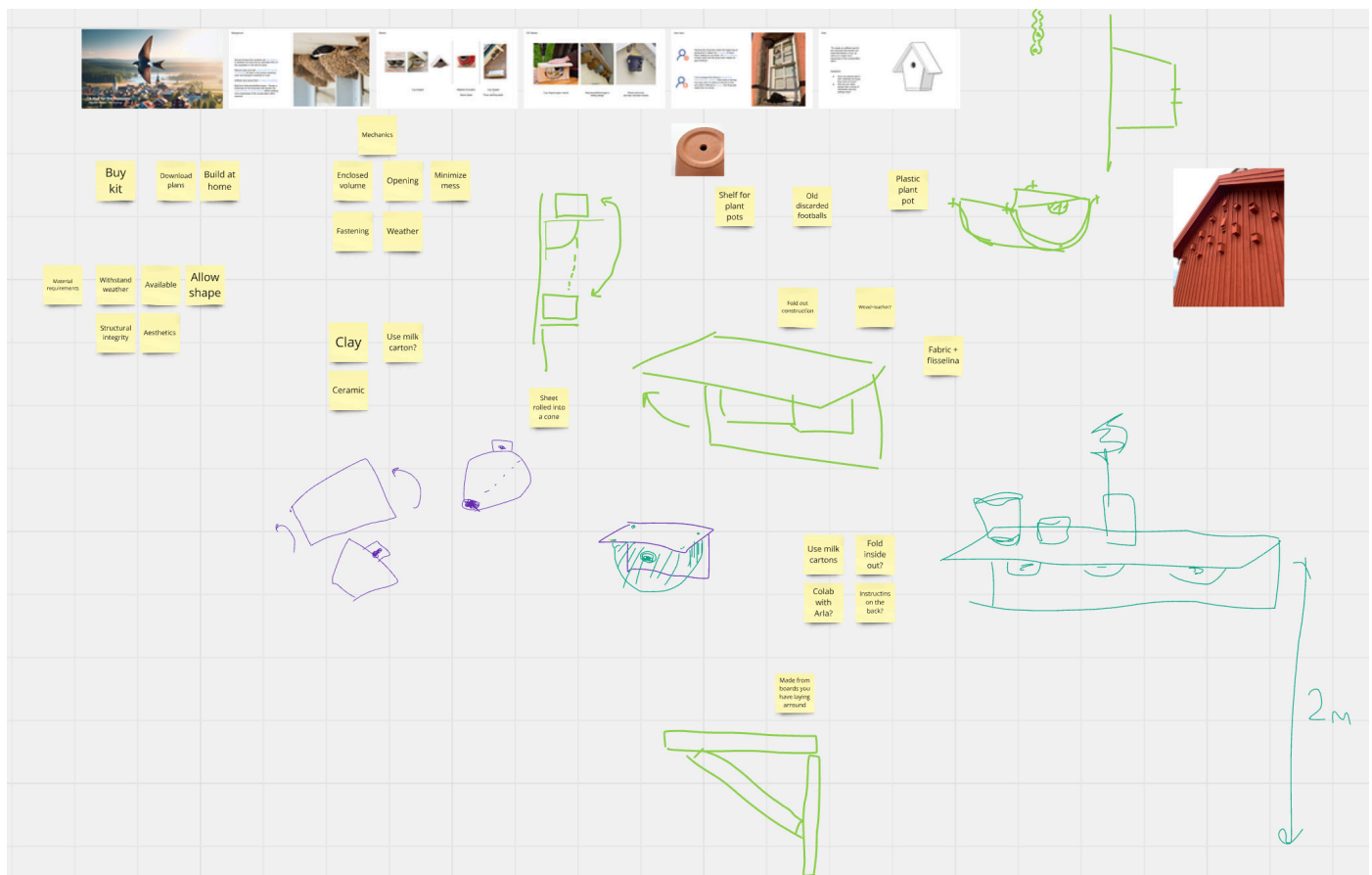


Figure 17 - Snapshot of the design workshop held together with Catino

The team at Catino was very intrigued with the idea of reusing materials available, something previously considered but without finding a worthwhile solution to pursue. Through this workshop with many presented ideas, one material not previously considered came forward; milk cartons. A waterproof and flexible material that can be cut using scissors and stapled or glued together. The material is even customizable through the use of paint.

THIS was an idea worth pursuing.

4.5 (Almost) Everyone drinks milk

What makes the discovery of the milk carton material so great? Europeans, on average, drink between 150 and 200 litres of milk per year (Landgeist, 2022). This means that there are roughly 150 milk cartons available per person per year that can be used to create an artificial nest for the House Martin.

Available to everyone

One of the factors influencing the disconnect between people and nature conservation is the financial means a person – or household – has. By using milk cartons that are already available and found in anyone's home, financial means are no longer an obstacle for participating in a conservation effort. There is also no distribution of materials required as the cartons are already available to people. Any instructions on how to build the nest can either be presented on the carton itself or online. This means that there are very few steps required between thinking about taking the initiative to help the House Martin and actually taking action.

Milk cartons are also a friendly material to work with. Kids aged three to four can already start using scissors (Scissor Skills | NHS GGC, n.d.), with an adult for supervision, and follow simple instructions. With them creating the artificial nest themselves there is a good chance they'll feel

more involved and responsible (Richardsson et al., 2020) for the wellbeing of the House Martins that they are creating their nest for. According to one of the experts consulted for this project, kids are often seen correcting their parents or other adults when they themselves feel more involved in a nature conservation effort. This feeling of ownership and responsibility can be seen in adults as well if they build the nest themselves, and could open the door to more advanced conservation efforts. One example would be of how these nests could lead to a better understanding of the House Martin numbers in Sweden and Europe when combined with an initiative similar to the one performed by Sveriges Lantbruksuniversitet. In this initiative people would report when a House Martin nest is used and if there are any chicks. This, in turn, would create a much more detailed picture of the health of these birds and where they are located each year.

The material

Milk carton is a material with huge potential to be used for an artificial nest. The inside of the carton, in this study referred to as the "cardboard material" is made to keep the milk from spilling out. The usage of this material allows for people to create a water resistant artificial nest that could withstand the elements for extended periods of time.

There is, however, one large limitation with using milk cartons. The material has a maximum size in which the nest, or parts building up the nest, need to be able to fit within. The total sheet of material available from a milk carton sized to house 1 liter of milk is 277 by 245 mm, but this includes carton parts that aren't ideal to use. The top most part of a flattened milk carton houses the cap as well as the folds that allow for the carton to be sealed at the top. These folds create an uneven surface when flattened and could interfere when creating a design that requires new folds. There are larger sizes of milk cartons available but to make the design as accessible as possible a smaller carton size was chosen to build the nest out of.

If the design works for a 1 liter carton, it will also work for 1,5 and 2 liter ones. The part of the 1 liter carton that is best suited for creating an artificial nest is slightly larger than an A4 paper. The cardboard material won't last as long as other solutions on the market, but could serve as a perfect stepping stone towards creating more awareness for the House Martin. People who do get excited about participating might be more willing to make the shift towards a heavier, more natural looking, and more expensive nest when they have already gotten to participate for "cheap".

The direction visualized

As part of my industrial design process I like to visualize the idea direction before starting with sketching actual solutions. These visualizations help with finding references and serve as a source of inspiration for the solution space. Figure 19 shows the visualization board for the nest made out of milk cartons. The main idea was to create a model out of a flat pattern that would be cut out of the carton. This would not only create a product with the right shape for the House Martins, but also leave people surprised with how this ordinary and often thrown away material is transformed from something flat and static towards something round and volumetric.

The visualization board served as inspiration for multiple new solution spaces. The common thread between them all is that people should be able to draw the pattern onto the milk carton themselves, and use this pattern as a guide to cut the right shape out. By merely using scissors and a stapler the users could create these nests at home, without specialistic tools or prior knowledge.

Prototyping

The next stage in a design process after finding a promising idea is to start creating prototypes. These serve as indicators to see if the idea on paper can be translated towards a 3D object, and if this object still functions as intended.



Figure 18 - The useable sheet of material from a milk carton



Figure 19 - The design direction and inspiration visualized

For the prototyping of the House Martin nest heavy grain paper was used.

The first step in creating the prototype was to understand how the flat shape should be dimensioned and cut. By creating two rectangular shapes as shown in figure 20 and connecting them using staples a cylindrical shape could be created. To close up the front one rounded shape was used. This shape also included the 35 by 25mm hole that would serve as the entrance for the House Martins. The luxury of using the heavy grained paper was that there was no need yet for splitting up the parts as would be required to fit them within the dimension of a milk carton. Figure 21 shows the nest when assembled. The goal of this prototype was to explore overall shape and leaving finer details such as how to close up the back or how to mount it on the wall for a later stage.

The prototype presented a product with a lot of charm that could easily be built by people at home. When multiple nests would be placed side by side it would create a visually interesting pattern that would enhance the appearance of a home or barn. The opening for the birds to use, however, didn't visually represent a nest that is supposed to be used for House Martins and could be harder to be recognized by people looking to build these nests to aid the conservation effort. Therefore the second prototype has improved on the first by changing the opening to become visually more representative of the natural nests, as well as some minor changes to aid in the construction of the nest. The improved version is seen in figure 22.

This prototype shows the potential of the idea, as well as improved upon it by changing some parts and characteristics. Now that it functions in the heavy grain paper it needed to be translated to a design that can be made out of the milk carton. Figure 23 shows the translated design into one that functions in the milk carton material. The design has improved on technical details such as

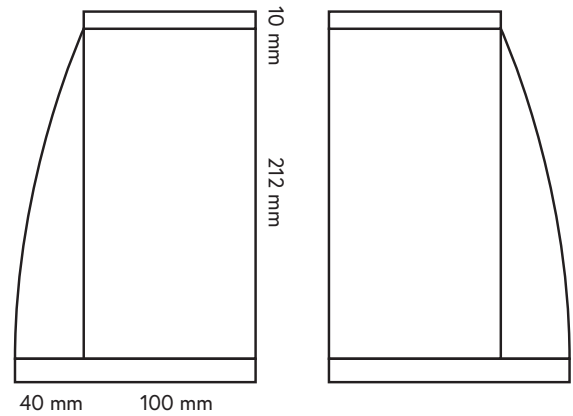


Figure 20 - Cutout pattern that is used to create the cylindrical shape



Figure 21 - The first prototype

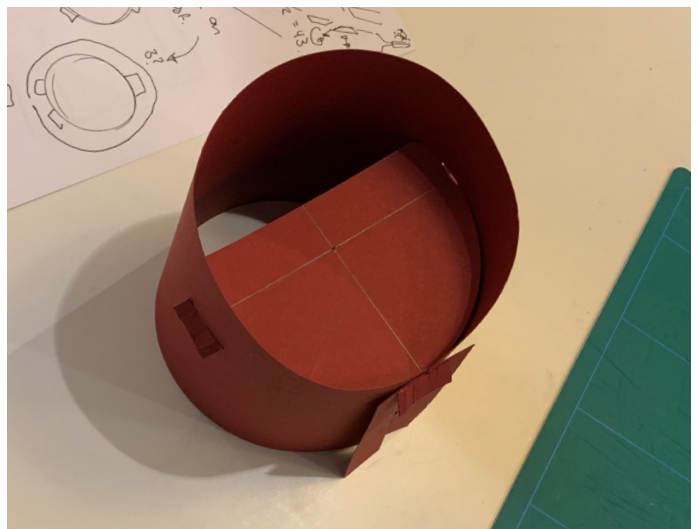


Figure 22 - The improved prototype

how to insert the front face into the body of the nest, as well as stapled the different parts that make up the body. The cardboard side is facing outwards to improve weather resistance, but could be flipped to allow for the nest to be painted.

Through a paint test it was discovered that the inner side of a milk carton does not take paint well, whereas the printed outside does.

Unveiling to the public

The prototyping phase presented enough learnings to create a final model that is ready to be reviewed by users and experts from a Facebook group called "House Martin Conservation UK & Ireland". Their 6000 members vary largely in demographic and, with their interest in and knowledge of the House Martin, they are arguably one of the best online sources to request feedback and input from. There is only so much research and design intuition can uncover, especially when it comes to the needs of the House Martins. The people reviewing the design have been able to scrutinize some decisions made and lay a foundation for future ideas and products. Their name suggests that they are only based in the UK and Ireland but the group has expanded all throughout Europe and has provided experts from the Netherlands, Sweden, and Finland. The prototype presented for review is shown in figure 23. The goal for this review was to understand if the needs of the House Martins would be met through the design of this artificial nest, as well as gauge the interest and support from the community.

Truth be told the design was met with skepticism. It was expected to get some pushback as the idea of using milk cartons, as well as the overall design of the product is very different compared to the artificial nests currently on the market. But what was not expected was that the design was still ways off from a product worth encouraging for the public to use.

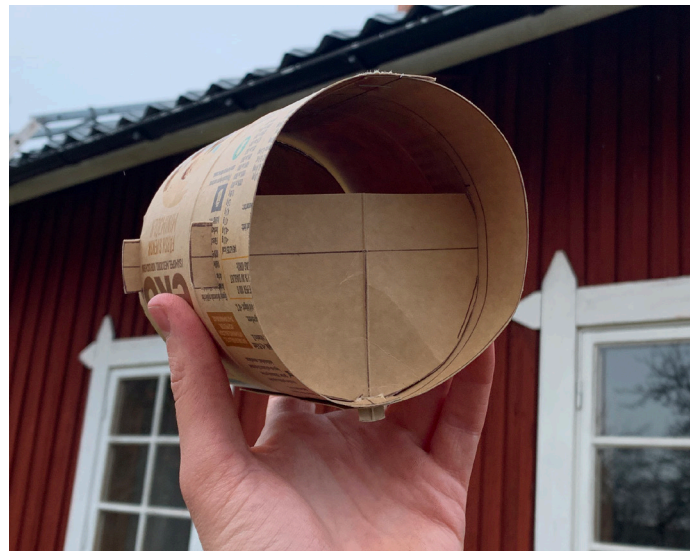


Figure 23 - The first House Martin nest shown as presented in the "House Martin Conservation UK & Ireland" Facebook group.

In total there were 57 comments on the nest design provided by both experts on House Martins, as well as "ordinary" people. Their comments varied and some were repeatedly mentioned. The most noteworthy ones being;

"Not so sure it would be strong enough to deter predators – it looks very short term"

"I would recommend reducing the opening size to 2 cm deep x 4 or 5 cm across otherwise in the UK we find sparrows taking over. Looks like a really good idea though love that anyone should be able to make them!"

"Not to be rude, but it won't work for House Martins as it is too vulnerable and open"

"My main concern would be the fact that chicks cannot reverse up to the entrance to eject their faeces. They will do this at an early age whilst still blind. Adults will clear most of them but something to consider for nest hygiene."

"I think it depends whether or not House Martins use them successfully or not."

"I like the thought but sadly can't see it being used, or if it does, more likely to fail or be predated."

"Fokke, I love a design that is simple and accessible to all and yours is both. It may have issues but if we never try anything new how do we move forward. The aim is to increase nesting opportunities, so if it does that it gets my vote. I would love to see it used, so you can see if there are any simple improvements that you can make. Do not be disappointed if you only get sparrows as you will still be helping nature."

The feedback was mixed but most of the comments came down to the design possibly being able to work for other birds, but not yet for the House Martin. This was further corroborated during a call with Class Frankena, an expert on the topic of House Martins from the Netherlands,

where they mentioned the following;

"The initiative is a good idea but the design needs to be improved. The opening isn't House Martin friendly and the location in which the nest is hung in the picture is incorrect"

"With the House Martin being one of the most vulnerable birds they need the extra attention to safety from the elements and protection from possible predators."

"It is important to conserve these birds as they are the natural neutraliser of the amount of insects and are standing between us and possible future insect plagues."

"Informing people of the conservation effort required, making them excited and creating the feeling that they are involved is imperative for your initiative to work. I believe that involving kids from as early an age as possible will bring forth the best results and if your design can be tailored towards kids then I think it could be a great stepping stone for the future"

"When people become more aware and feel more involved with the House Martins surrounding them I believe they will not mind the poop below the nests as much, or at all. They could even put a plant pot underneath as it functions as a great fertilizer! This poop could even be used to collect DNA from the insects they eat in the natural landscapes."

"The dimensions you have used to create your nests are correct and would be attractive for House Martin. The overall shape, however, is currently not yet suited to attract and protect the birds"

4.6 Simplicity is key

The first design made out of milk cartons that was reviewed by experts and users from the Facebook group has been received with mixed feedback. The main takeaway was that the initiative is good, but the execution needed to be improved upon. This is further corroborated by the comments from the expert from The Netherlands.

The dimensions of the nest are good but the shape needs to be changed. In order to explore as many different shapes a large variety of concepts has been created, each with the aim of testing them in the physical space. The new

angle or addition to that characterizes this design phase is the initiative to create more intricate cutout patterns. These allow for nest designs that are better adjusted to the requirements from House Martin or more explorative in its design. They do come at the cost of the users now being required to print the designs out themselves. These printouts would then need to be secured on top of the milk cartons and cut out in a semi-precise manner. There are three milestones within this design phase that characterize the development of the nest design, each with learnings from previous iterations.

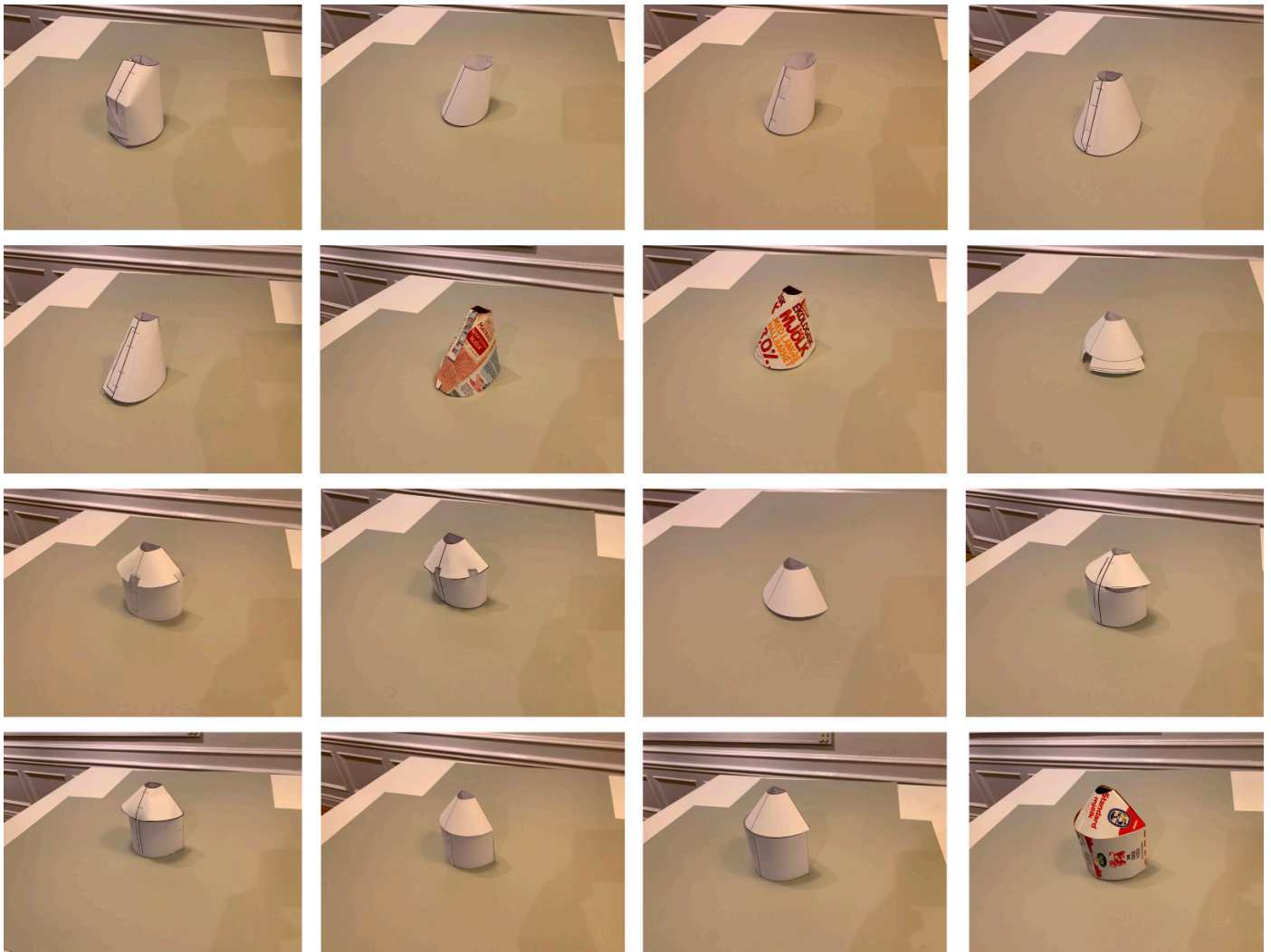


Figure 24 - An overview of most of the prototypes made for this design round

Waypoint one - prototype 4

The first waypoint from the roughly 20 prototypes made is one inspired by using a cone shape. These shapes are one often created using a flat cutout pattern that is then folded by the user to create the cone. Instead of designing a regular cone, which could be seen as something not designed with either people or the House Martins in mind, an alternative shape was created. The flat cutout pattern is seen in figure 25. The shape has been created by cutting the final design in half and, with only one fold and a few staples, it would be very user friendly to create. The opening is much better dimensioned and follows the demands given by experts, being 35 by 25mm. When the user has folded the cutouts and stapled them together they will have ended up with the artificial nest as shown in figure 26.

To understand if this design is moving in the right direction the same expert from The Netherlands was consulted. They concluded that the shape is much more interesting but, because the body is angled towards the wall, that it would not work for the House Martin. When the birds would lay their eggs they would roll towards the wall and either crack or lay in a position where they couldn't be brooded out. They did agree that the opening of the nest is much better dimensioned and, since it is placed further from the main compartment of the nest, offers the protection required from predators or other birds. Lastly they argued that the nest would require to be bigger as it could house as much as 8 House Martins at the end of the season. This design already used the maximum amount of space available within the milk carton and other options required to be explored.

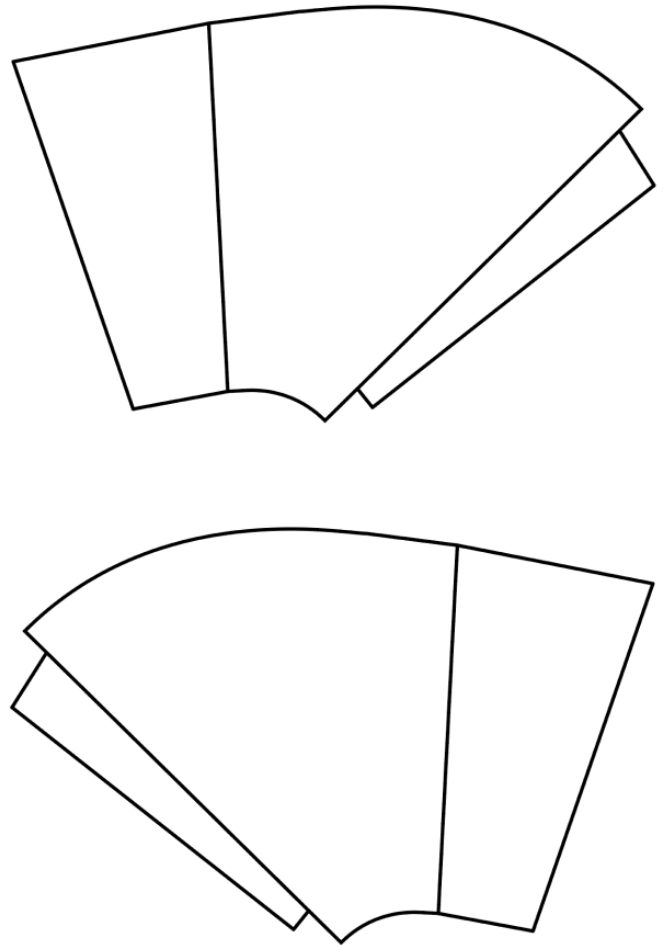


Figure 25 - Prototype 4 cutout patterns



Figure 26 - Prototype 4

Waypoint two - prototype 12

The next waypoint in the design process was the creation of a nest which continued on the cone shape that converges towards the opening whilst taking inspiration from the first carton nest presented to the public. Its cylindrical body utilized the milk carton material much more efficiently, but the top half would not be used by the birds. By halving the shape a design was created that was much more tailored to the requirements of the House Martin. The second waypoint also continues with the exploration of a design that only requires two milk cartons in order to realize the nest. The shape for these cutouts is shown in figure 27.

When looking at the cutouts assembled together into the artificial nest prototype shown in figure 28, it immediately shows that the angled body has been removed, allowing for the eggs to stay safe and increasing the success when brooding. The opening of the nest is still placed further forwards and with this combination the nest both has an opening further away from the place where the birds will be nesting as well as a horizontal platform where the eggs won't go anywhere, allowing the birds to brood in peace.

The main flaw with this design is how the front of the nest and the main body can't overlap to create a nest without gaps. This is due to the way in which the cutout has been constructed, as both the body and the front stay connected. This gap can allow predators such as woodpeckers to pry the nest open and take the eggs, chicks or even adult birds. They could also expose the birds in the nest to the elements and run the risk of the nest becoming too wet for the chicks to survive. The design was a definite improvement in the right direction but more development was required.

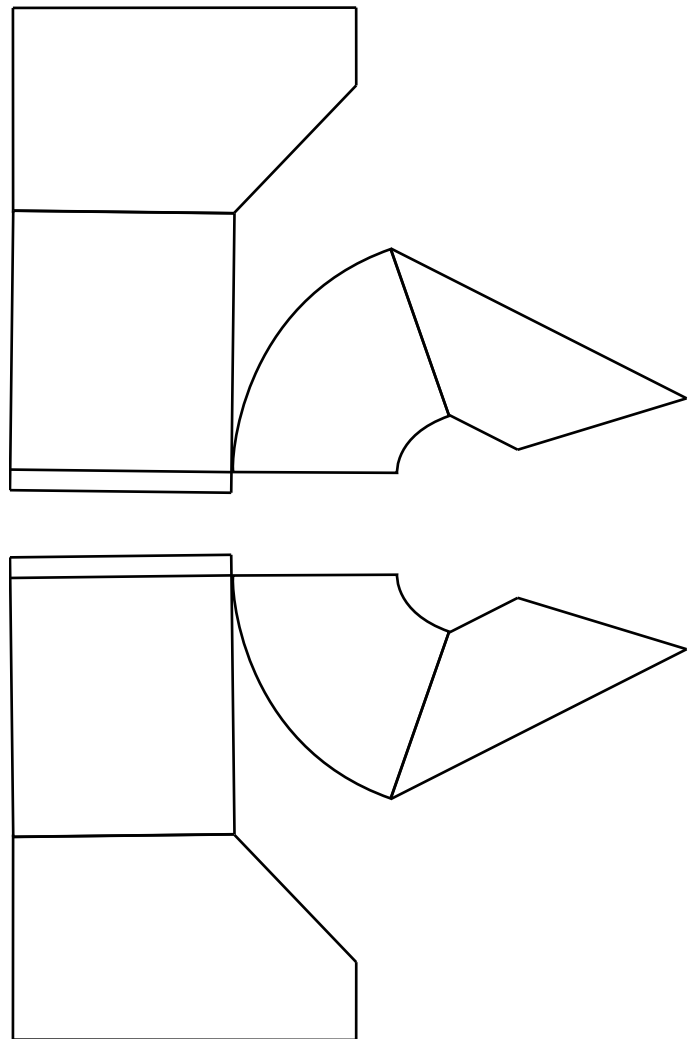


Figure 27 - Prototype 12 cutout patterns

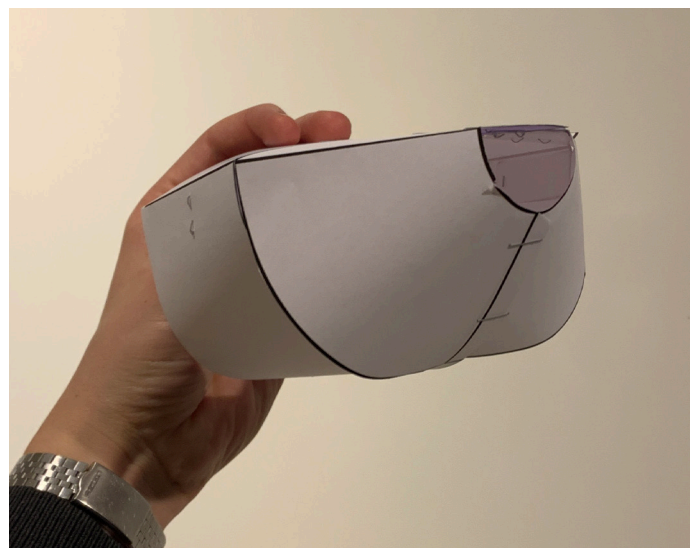


Figure 28 - Prototype 12

Waypoint three - prototype 19

The last waypoint was created with the idea of combining the best of previous prototypes and removing the gap that could prove to be problematic. This was done by creating a space between the main body and the front face, allowing for it to be flipped inside. Figure 29 shows the last cutout design, and how the front face is spaced further from the rest of the nest.

This nest design would still use two milk cartons to be realised and utilizes the wall to close up the back of the nest. When looking at how this design is executed in reality it shows just how much stress points there are in the nest when everything is supposed to be connected using mirrored cutouts. There is no wiggle room and gaps start appearing quickly, leading to the nest looking like an incomplete product and would require many changes to be made in the assembly methods. The nest does not communicate a sense of user centeredness due to many flawed areas that would make it hard for the user to be proud of when creating the nest. The initial idea and improvement were good but proved to be hard in execution, requiring for a decision to be made regarding what a feasible design could be and present this chosen solution towards the group of experts and expert users.

A design ready to present

The goal of this design round was to create a new artificial nest solution that could be presented towards the same experts and expert users as before. They are already familiar with the idea of using milk cartons as well as trying to make nature conservation accessible to more people. After the creation of over 20 unique physical designs that each improve on the flaws of the one before, a final nest was created that proved to be good enough to present. This nest was presented as shown in figure 31. As with the previously presented nest design, the purpose of the feedback is to gain insights into the overall shape and idea before concerning myself with creating the finer

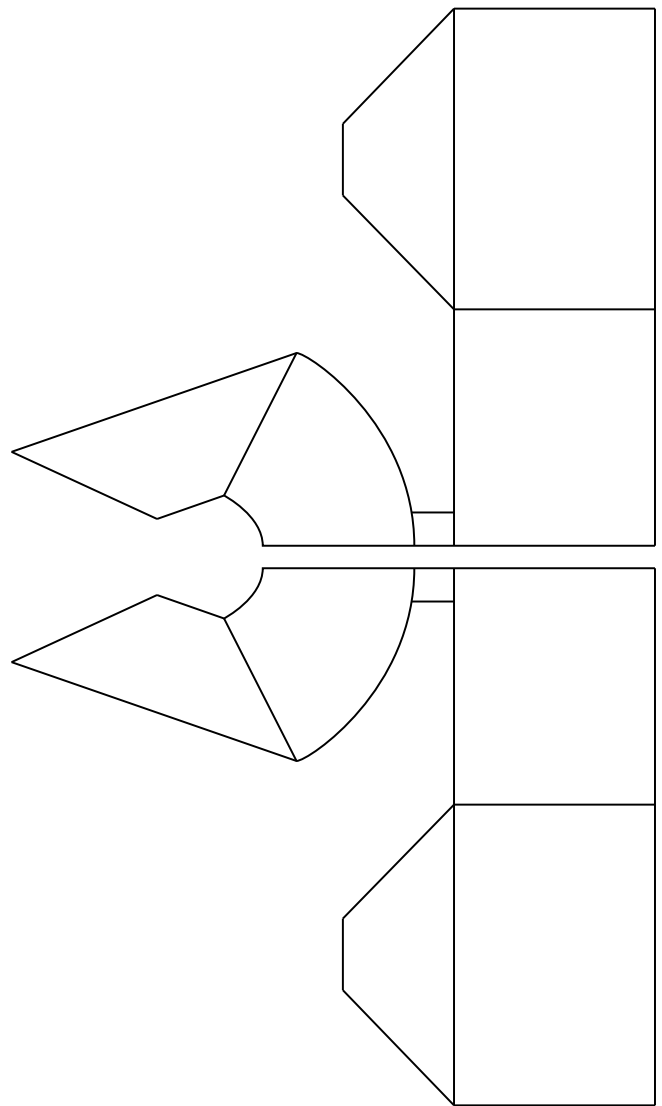


Figure 29 - Prototype 31 cutout patterns



Figure 30 - Prototype 32

details such as how to hang it up on a wall and how the back of the nest could be closed up.

Out of the three waypoints that were shown on previous pages the presented design looks the most like an improvement or continuation on prototype 12. This is because the development after this moment has created nests further away from the intended idea and a few steps back had to be made. The main learning from waypoint three was to insert the front face of the nest inwards to eliminate the risk for gaps. This has improved both the safety for the birds, as well as the structural integrity of the nest.

The nest was better received by the members of the House Martin Conservation UK & Ireland facebook group than last time. Still, not everyone was convinced and the nest, as well as the idea, received critique. A comment from one member sums up the feedback best;

"I think for me it is comparing the cost to people versus the cost to the house martins. Making a nest out of a cheap and readily available material is good for humans, because it doesn't cost very

much. Making a nest out of an untested and flimsy material, which stands a good chance of failing mid way through the nesting season, costs the house martins all the time, effort and heartache of laying, raising and then losing their chicks. They might go on to re-lay, but it's not guaranteed they will have the time or energy to do so. They could lose a whole year's young. Certainly they will lose the chance to raise a second brood that year. I'm worried that the martins end up raising fewer chicks as a result of humans providing nests made from unsuitable materials."

Their concern is valid and an ethical one. The material is untested under the circumstances and does require some trial and error which might unfortunately harm the House Martin in the short run. At the same time the benefits for people, such as the readily available material as well as the low cost, could see more people active in the conservation effort and ultimately being more forgiving towards natural nests. These comments are part of a larger ethical question and will be further addressed in the discussion chapter.



Figure 31 - The new design as shown towards the group of experts and expert users

Like before, the nest was also shown towards the House Martin expert from The Netherlands. They believed the nest was a big step in the right direction compared to the ones previously shown. As the expert already makes professional artificial nests that are being sold, they mentioned that they wouldn't use the milk carton solution themselves each season, but they would definitely be open to using it during emergencies. This would be in the case when a natural nest has failed and the surviving chicks and/or eggs need to be relocated to a better solution. These last insights, combined with the comments from the facebook group, have given enough insights



Figure 32 - Early exploration on how to close the back

4.7 Perfecting the design

The design presented towards the Facebook group functioned, but lacked details such as how to close up the back and how to hang the nest underneath eaves. In order to create a functional design changes needed to be made.

The first major change to the nest design was to cut it up into multiple parts instead of trying to combine as many features as possible in a singular cutout. The base nest for the design improvements has been divided into 4 parts; the top of the nest, the front of the nest, and two parts that make up the cylindrical body.



Second was the need to explore as many different variations on the design as possible, adding the details required to create a final product. Figures 32 until 39 show how the design was further developed. Each development improving on the previous variation made and explored using different materials.

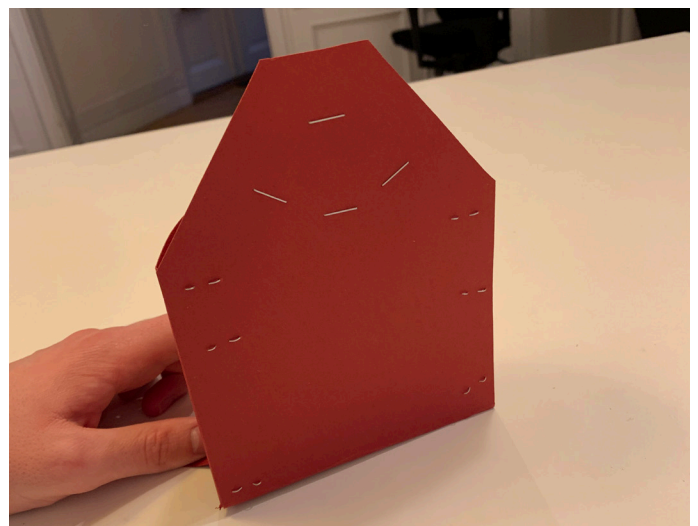


Figure 33 - Early shape exploration

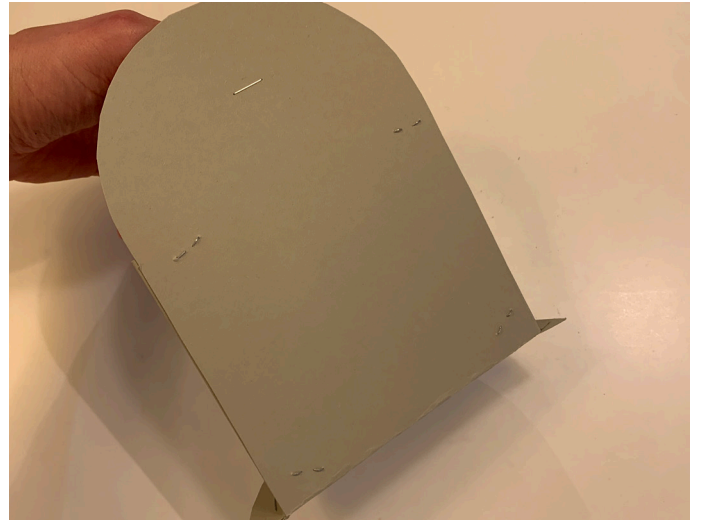
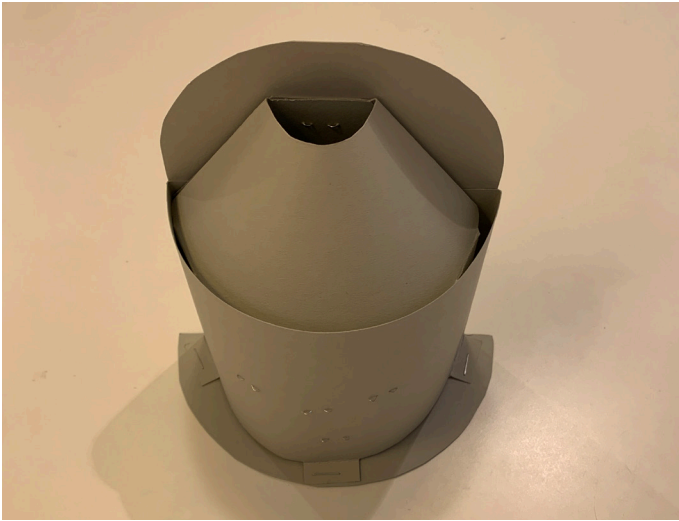


Figure 34 - Exploration on the overall shape

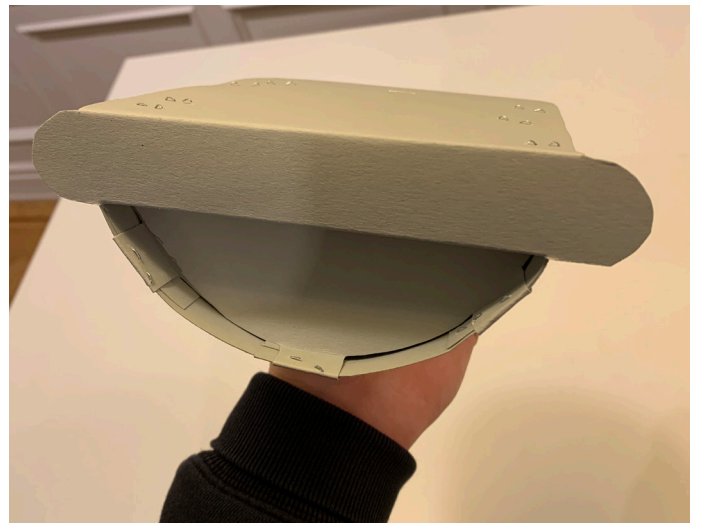


Figure 35 - Continued exploration on how to close the back

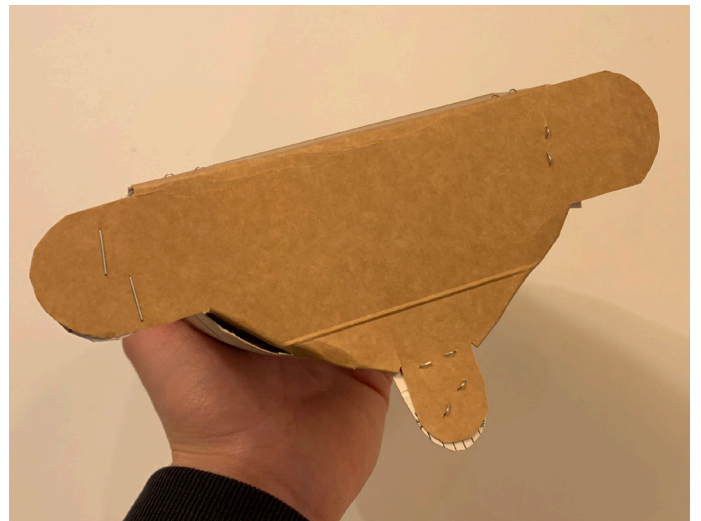


Figure 36 - Further explorations

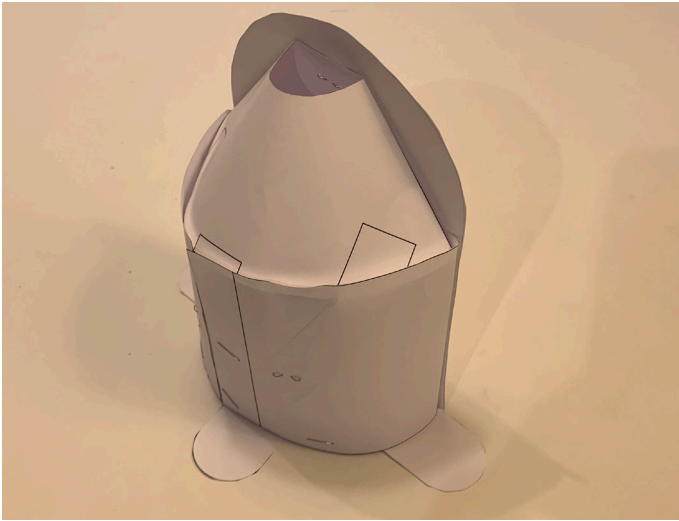


Figure 37 - More explorations on the overall shape



Figure 38 - Prototyping using the milk carton material

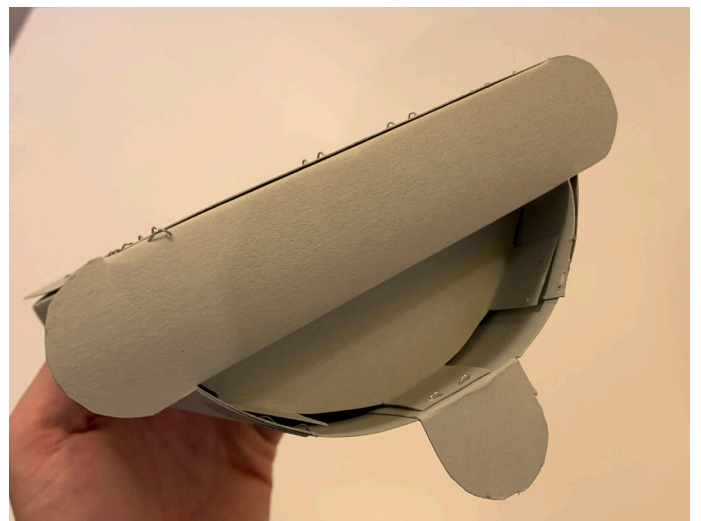


Figure 39 - Beginning of the final design

The Final Design

Through the creation and development of many prototypes, each with their own characteristics and features whilst improving on the flaws of its predecessor, has allowed for a final design to be created. This final artificial nest design is shown in figure 40.

The nest is built up out of three milk cartons that people cut using printed cutout together with folding instructions. The only tools required to build the nest are scissors, a stapler, and a ruler.

This allows for users, both young and old, to build the nest without requiring special tools, skills, or previous knowledge.

The choice to face the cardboard side outwards is a deliberate one as this side is the most water repellent. An ongoing test has been started where nests were hung outside in December 2024 and at the time of writing, March 2025, they have held up without showing any signs of water damage. This will be further discussed in chapter 4.8.

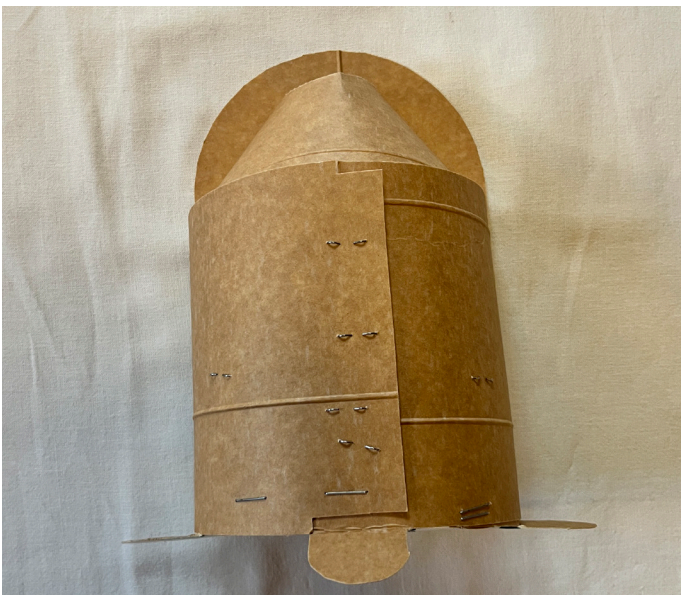


Figure 40 - The final product

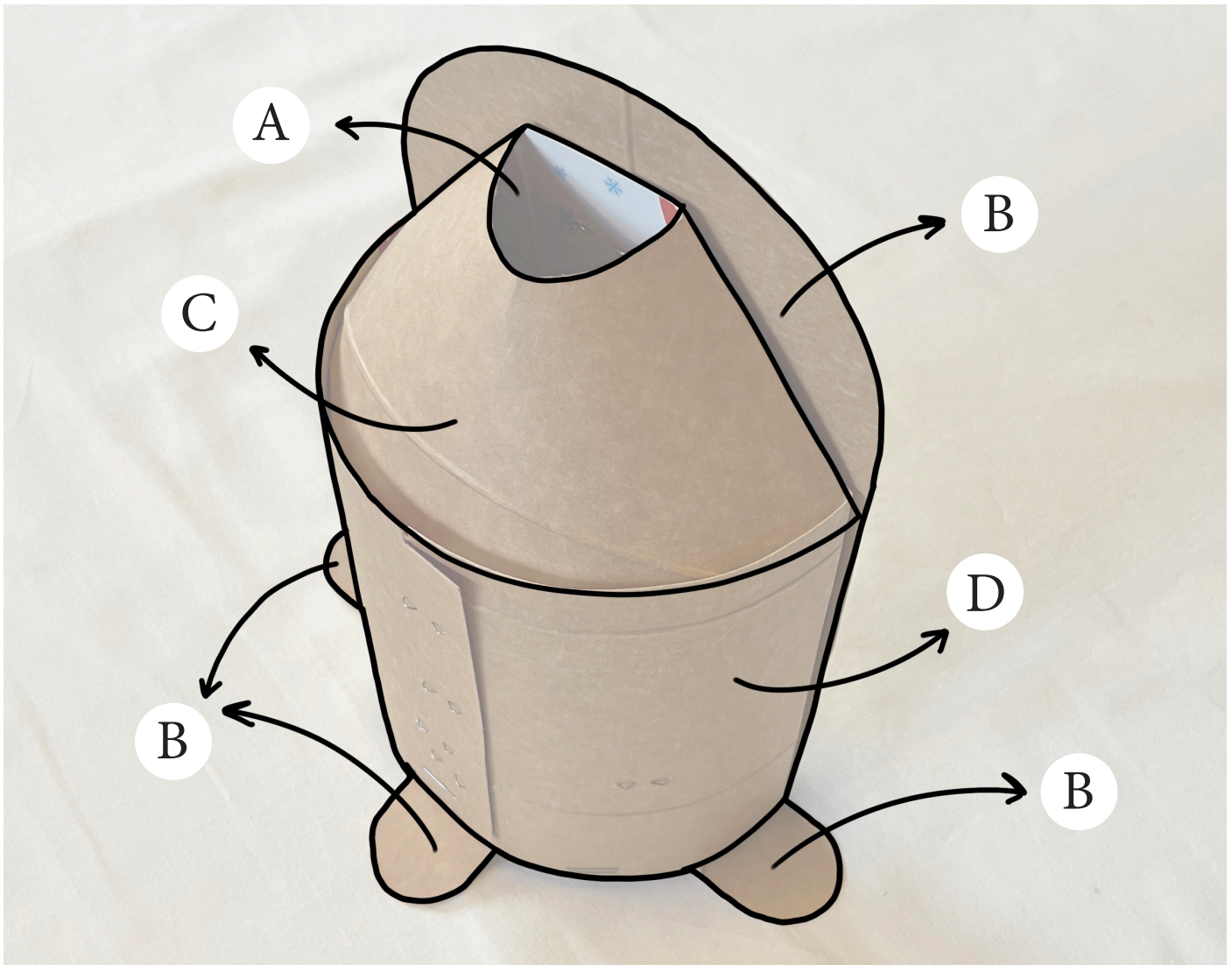


Figure 41 - The final product with each unique feature highlighted

Taking the nest apart

- A. The opening of the nest is dimensioned to the ideal size for the House Martin to use, 35mm wide and 25mm tall.
- B. There are multiple ways in which the nest can be supported underneath an eave. One method is by using the four flaps on the back of the nest to attach it to a wall. The other is by using the rounded surface above the opening of the nest to attach it to the eave (roof) itself in combination with three of the four back flaps, leaving the one pointing straight up unused as it cannot be reached.
- C. The front of the nest is dimensioned so it moves the opening away from the nesting chamber by 50 millimetres. The angle is also kept from being too steep to make it possible for young chicks to be able to crawl to the opening to defecate. This feature, however, does require further testing.
- D. The overall size of the nest is within the favourable dimensions, being 110 mm wide, 110 mm deep, and 55 mm tall. These dimensions allow for the birds to brood and sleep comfortably in the nest.

Cutout design

The final design is built up out of five different parts. They are complicated enough that users require special cutouts that guide them to cut the milk cartons in the right shapes. The goal is for the user to print the designs shown in figure 42 and staple them on top of a flattened carton. Due to the fact that milk cartons already have hard folds present on the material it was important to make sure these didn't obstruct the design for the House Martin nest. The cutout designs are orientated in such a way that they fit correctly on top of any carton. The user is then able to use scissors to cut the parts out of the milk cartons by following the solid lines.

When the parts are cut they need to be folded in certain places too. These folds should be as sharp as possible to ensure that the parts fit properly when assembled into the nest. The users will be instructed to overlay the cutout designs on top of the milk carton parts. They should then fold over the dashed lines with the assistance of a ruler. This is both a kid-friendly way of creating precise folds, as well as simple and understandable for people who aren't familiar with DIY.

With the parts cut out and folded in the right places the user will be ready to assemble the nest.

4.8 Testing the nest

The goal of the artificial nest is for anyone to be able to make them at home. As the designer of the nests I can almost do it blindfolded. The big questions are; will the user be able to build it too with the right instructions? How will they perceive the nests they built? And can the nests last a season outside?

This chapter is the last in the development of the artificial nest. As mentioned previously; due to time constraints this exploration is limited, but meaningful nonetheless!

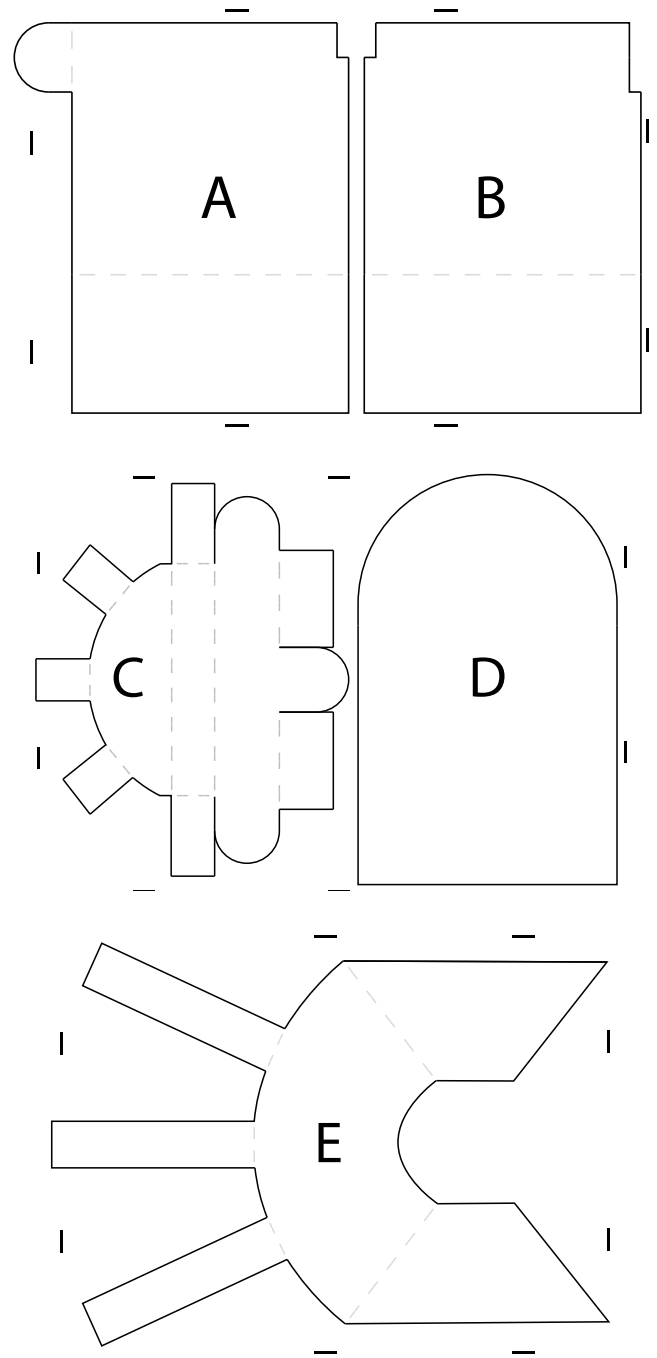


Figure 42 - Cutout pattern for the final design

To optimise the testing the goal was not to see if the instructions are understandable, or if the users were able to create a perfect copy of the nest. As perfecting user instructions could take an amount of time that was not available during this study, the choice was made to test for an emotional connection instead.

Usability test

Six users were asked to build the artificial nest using whole milk cartons. Their insights allowed preliminary conclusions to be drawn of how users perceive the process, as well as the resulting product.

The usability test was done by 6 individuals aged 24 to 61, two men and four women. The users either built the nests alone, or with two at a time. Improvements to the instructions were made between tests. These changes impacted the user's experience with the assembly of the nest positively. The initial idea was to mimic the way in which IKEA creates their instructions. The illustrations are shown in figure 43. For the complete instructions please see appendix two. By creating these illustrations the user could easily see which side needed to be "up" and where to staple.

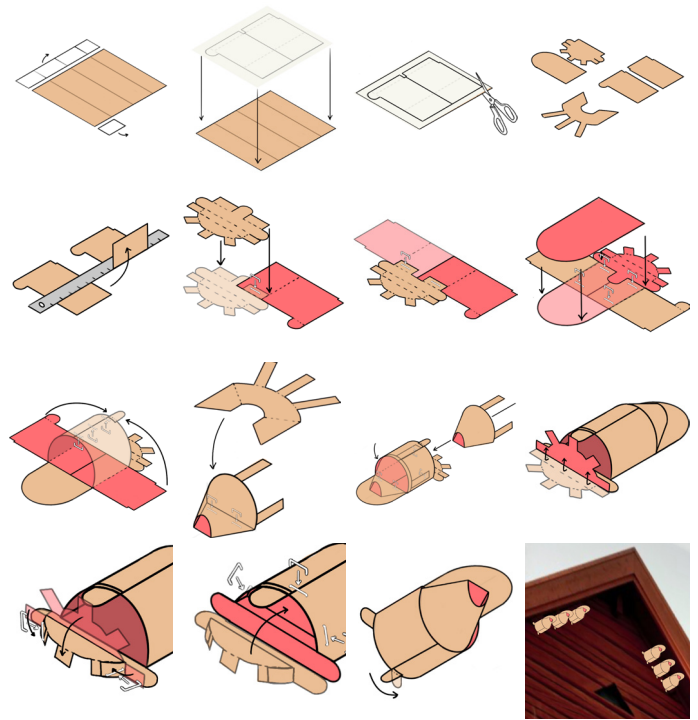


Figure 43 - Illustrated instructions without text

Not everyone built the nests the same. Both visual as well as written instructions were provided. The users who followed both at the same time made nests that closely resemble the final design. There were minor mistakes or misunderstandings but they didn't affect the overall function of the nest they created. This wasn't the case for everyone, however. One of the users expressed that they had a hard time concentrating on the text and prefers to solely use the visuals. They did not experience the visual instructions as understandable enough to create the nest. Their impatience with the steps also showed where the instructions were lacking. They presented the feedback that they would prefer actual pictures that depict the steps better than digital visuals. Figure 45 shows the new directions for the visuals using images instead of illustrations. The complete instructions can be found under appendix three.

These images were presented towards two users with the same written instructions that supported the illustrations. Important to note is that this tests wasn't done with me present. These users

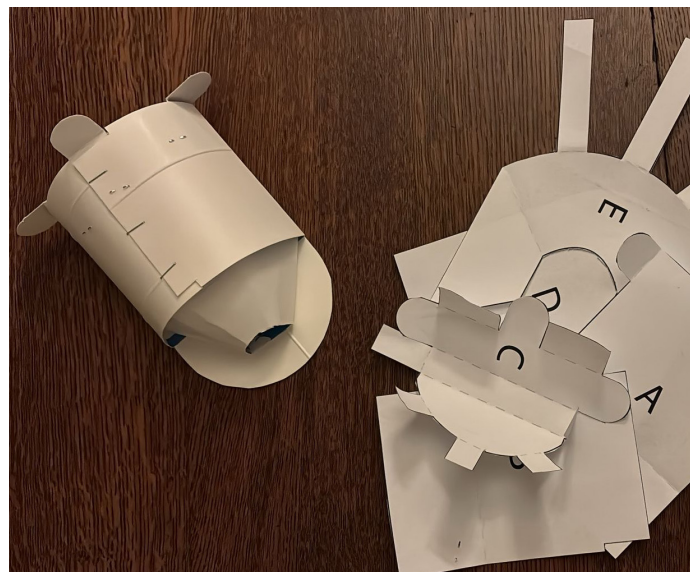


Figure 44 - Nest built by users in The Netherlands

were located in The Netherlands and received the instructions through e-mail. Their resulting nest are shown in figure 44. These users being able to build the nest in an entirely different country without the need to be supplied with materials highlights how the design is truly accessible to all. They already had milk cartons at home that could be used right away and at no extra cost.



Figure 45 - Images that the user was instructed with. These were strengthened with text.

Usability test results

There was not enough time for the usability test to result in foolproof instructions that are ready to be shared with the general public. What the test did uncover, however, was the immediate emotional connection that users felt towards the nest they created. Most users were not aware of the existence of House Martin or their decline before creating the artificial nest. One user expressed the following when asked if they feel connected to the House Martin after creating the nest.

"Of course! And if it would be used by birds as intended I would think it's fun, anyone would."

The users also expressed that they could see themselves creating these nests to support local House Martins. Before every season if required. They expressed that this was further encouraged as they viewed the nest as "free". When asked what they meant by free they expressed that:

"As I paid for the milk inside and not the carton I have already paid for what I wanted to consume. Instead of throwing the milk carton away I now get to create a product for free".

After the completion of this thesis, the usability testing will be continued. The instructions will be improved both visually and written. These improvements should allow for more users to create the nests independently. There are already a handful of locations where the nests can be hung up during the 2025 season in Sweden. The goal is to expand this number and involve people and locations all throughout Europe. This should be a great way of testing whether or not the House Martin will accept the milk carton nests as a suitable nest.

Weather test

After the completion of the final design three nests have been hung up on a balcony in Stockholm, Sweden. The planks they are hanging on



Figure 46 - Weather test of three nest variants

simulates an eave. The three nests differ in their method of suspension. The top most nest is hung to both the wall and overhang. The middle nest is hung to the wall using four flaps. The bottom nest is hung to the wall using three flaps. Each nest is secured in place using a stapling gun. An alternative method for this could be nails.

The three nests were hung up early December 2024 and over the next period of 2 months the nests have endured rain, snow, frost, thaw, and storms. The wind speeds during these storms reached a maximum of 30 kilometers an hour, in one case for four days straight.

Figure 46 shows the state of the nests on the 16th of January 2025. They still are as secure as they were in December. They do, however, require testing for longer periods, both with and without usage from House Martins.

4.9 Future outlook

Even though the final artificial nest is still under development, and requires further testing, a future outlook of what a part of the final product could look like can already be illustrated.

The nest has been created to initially be shared with users on the website of Naturskyddsföreningen. They already have instructions on how to make nests for other birds and users are aware that this is a great location for finding nest designs. In the case for the House Martin nest people would get instructed on how to build the nest using milk cartons themselves. The cutouts would require to be printed by the user at home and stapled on top as mentioned previously. This method of presenting the design, as well as attracting people to aid the conservation effort, is functional but can definitely be done differently to attract more users.

For example; what if the design could already be printed on the milk carton itself? This could create a much larger exposure with people unfamiliar to the conservation effort. Most Swedish households drink milk and therefore already have the cartons available. If the cutouts were already printed on the carton as illustrated in figure 47 it could invite more potential users to be involved. These cutouts would be accompanied by a QR-code that would refer to the Naturskyddsföreningen website. Here users would find all the instructions they need on to build the nest themselves.

This low-threshold of the artificial nest could encourage anyone to build the nests for fun. They could even be used to start larger initiatives such as kids building nests at home, for them to be later hung up in public places where the House Martins are known to visit. These locations could become places where kids get more exposure to nature, as well as meet other likeminded individuals to share these experiences with.



Figure 47 - Illustrated mockup of the cutouts presented on a milk carton

Discussion

This master thesis contributes to the research in the field of nature conservation by exploring a user-centered design process and the possible benefits gained. This has been done through applying this method of designing in order to create a new take on an artificial House Martin nest. This nest has presented a direction that should create excitement and willingness to participate from the users. But how has user centered design impacted this study, and what potential does this method have for future conservation initiatives? These and more questions will be discussed in this chapter.

The impact of user-centered design

This study was aimed at understanding the impact that user-centered design could have on nature conservation products. It was previously believed that most conservation initiatives were created with nature needing protection as the main stakeholder. This so-called ecocentrism has resulted in users feeling overlooked or created an environment that is far less interesting and accessible for many people. By applying a more user-centered approach by, for example, involving users throughout the process, initiatives could increase their participation rate at later stages. Involvement could be as simple as asking users for feedback, or as complicated as requesting the users to source materials and build products themselves. The IKEA effect presents an interesting take on people building their products themselves. Many products aimed at nature conservation are sold pre-assembled and only require people to hang them in the right place. By involving the user more in the process of building the product, understanding how it is put together, and by creating a sense of pride over the activity, it creates a much larger feeling of connection with the product. This user-centered mindset would create products that have been enabled to fit both the users and nature.

This is not to say that ecocentrism should be disregarded in a design process, but rather to find a better balance between the nature needing protection and the users tasked with taking initiative to protect.

Furthermore, by being aware of all the thresholds that could stop or prevent users from participating, conservation efforts have the opportunity to regard these critical problems as opportunities. The examples of artificial House Martin nests being expensive shows how they were created from an ecocentrism point of view. The nests need to fit the birds, and will come at a cost for the users. Many, less financially capable, users were excluded from participating whether they were willing to or not. By creating a new nest from a left-over material that most users already have at home a solution was created that didn't discriminate - allowing everyone to participate. Advice for future conservation efforts; in order to allow as many users to participate, the effort needs to be accessible to all, both young and old, regardless of income, education, and/or descent.

Spreading awareness

As highlighted in this study; not many people are aware of the need for nature conservation. The House Martin decline has largely gone unnoticed and potential users are not aware of the positive influences they could have. Research question three asked how the design of the artificial nest could spread awareness for the need of nature conservation. The answer in this case was by using a material that is available to everyone. This was used in combination with either online or physical marketing, printed on the milk cartons themselves.

It is recommended for future nature conservation initiatives to take some of the learnings from this study and apply it on their own. By being able to keep the thresholds to participation as low as possible you would be able to reach a maximum potential of users. This would, in turn, dramatically increase awareness spread through word of

mouth. The thresholds could be the price of the product or initiative, but also how easy it will be to present, or how acquireable a product would be.

Second, children should be involved whenever possible. Yes, this would create environmentally conscious adults, spreading awareness long-term. But they would also bring their awareness, emotional connection, and possible excitement home. In a meeting with House Martin expert Claas Frankena they highlighted that in their experience children often bring nature initiatives into their home. According to them it is often the initiatives that start in a classroom that can have the biggest impact on its surroundings.

Ethical considerations

The implementation of an untested artificial nest provides an ethical dilemma. The success of the developed artificial nest depends on the interest by the House Martin to actually use it. This interest can only be gauged by hanging up the nest and seeing how the birds will react and, as there are no known House Martins in captivity, this can only be done by wild birds. They are only in Europe to brood for a specific amount of time which is not to be wasted. There is a possibility that the birds could end up not being interested in the nest in which case the nests that are hung up could disturb a location that would otherwise see natural nests built.

The second ethical concern surrounds a comment left by a user as feedback from an earlier presented nest. They expressed that "making a nest out of an untested material, which could fail mid way through the nesting season, costs the house martins all the time, effort and heartache of laying, raising and then losing their chicks". The concern they express is a valid one and rightfully so. The milk carton material that is used for the artificial nest has been untested for this use case. Besides being exposed to the elements for the 2 months during this study no other tests have been performed.

Being exposed to the elements for months at a time risks the chance that the nest could fail partly through the season. Unfortunately the only way to find out whether or not the nest will be used by the House Martins and if it can survive for a whole season is by putting it to the test during a nesting season. There is a risk that the design of the nest leads to failure which will require quick adjustments to be made. These failures might bring short term damages in the hope for long term success.

Sustainability considerations

The artificial nest designed during this study has become a very sustainable alternative by repurposing waste material. Once people have drunk all the milk inside the carton they are left with something often perceived as trash. There have been more initiatives to reuse milk cartons with the focus on what the material can do for consumers once all the milk has been drunk. These initiatives have, however, had more focus on short term success, such as a recent initiative to use cutouts from a milk carton as an underlay to create gingerbread houses. After an afternoon of building the cartons would be thrown away. Not many initiatives have tried for longer term success like the implementation idea for the House Martins. There is a chance that the nest won't last an entire season and therefore the product might not be a sustainable alternative to the natural nests. It won't be able to mitigate the nesting failures and could perhaps only be used as an emergency solution when a natural nest is damaged or destroyed. The initial weather test done for this study, however, is showing promising results but does require further testing. When the artificial nest has been proved to work for the House Martins its sustainable impact could be further explored.

Could there be a possibility of presenting the cutout designs on the milk cartons themselves? This would eliminate the need for people to print the cutouts themselves if the patterns are already pre-printed on the carton.

The initiative to repurpose the cartons can also be extended for more animal species in need of a temporary home.

Finding the right users

The success of the new artificial nest depends on whether new users are interested in participating. One of the problems during this study was that, as everyone should be able to be involved with the House Martin conservation effort, finding the right users to involve that could represent "everyone" proved difficult. This is why the Facebook group "House Martin Conservation UK & Ireland" was chosen instead. They were of a large enough size to include many demographics and included potential users from all over Europe. It was also believed that if they, as people who are involved in more conservation efforts and with existing emotional connection to the House Martins, are convinced by the design that others potential users could be too.

Future development

The resulting artificial nest from this study fulfills many of the goals on paper. It should be more accessible to all; it should create more acceptance and emotional connection; it should also be easy to build by people at home. Due to the time limitation these predictions are currently based on research and initial testing but lack larger experiments. The period after the delivery of the thesis will be used to further implement the design. This future development can be cut up in four topics;

- **User testing;** The nest and assembly instructions need to be tested with more users, and especially users that do not have prior knowledge of the project or the House Martin as a species. These tests would result in a better understanding of the impact of the nest on the acceptance towards and emotional connection with the birds, as well as uncover whether the nest is easily built by people at home. Changes will be made according to feedback and implemented on-

the-go and it is therefore crucial that the user tests aren't all done at once but after moments of improvement instead.

- **A/B testing;** The instructions will most definitely change between usability tests, with A/B testing being the ideal way to understand which methods work best. In these tests two or more user groups are presented with one of two different instruction styles. The results and user feedback allow for directions to quickly be identified. It is important to create instructions that function well before the arrival of the House Martin in Sweden, or even Europe, to ensure that the full brooding season can be used to test the design.
- **Acceptance testing;** The House Martin is known to be picky even with already existing and successful artificial nests. To know whether or not the artificial nest created in this study will be accepted, it should be hung up in multiple locations in Sweden. Ideally this would be expanded over Europe where the birds are known to nest every season. There are already arrangements made at the time of this study to hang up some nests in Sweden. When it is known that the nests are seen as suitable by the House Martins in the 2025 season then the design can be further promoted to all consumers, hopefully increasing the numbers of House Martins in Europe from 2026 onwards.
- **Collaboration with milk suppliers;** One of the major positive accessibility impacts would be if the design can be presented on a milk carton. Either with the cutouts and instructions already printed on the carton, or by utilizing the backside of the carton where information pages are most often found. This would require a collaboration to be started with milk suppliers or companies in charge of creating the cartons and should be done with the help of Naturskyddsforeningen.

Conclusion

This study set out to explore how user-centered design can contribute to the conservation of the House Martin by creating a nest that is both functional for the birds and accessible to people. The resulting design—an artificial nest made from repurposed milk cartons—demonstrates how conservation efforts can become more inclusive by lowering participation barriers and engaging a wider audience.

By utilizing readily available materials and simple household tools, this project ensures that individuals of all ages and backgrounds can take part in the conservation effort. Additionally, the design actively encourages children's involvement, fostering early connections with nature that may lead to long-term environmental stewardship.

While the artificial nest meets its intended goals in theory, its true effectiveness will be tested during the upcoming House Martin breeding season, starting in April 2025. The results from these real-world trials will determine whether the design is both viable for the birds and practical for users. If successful, this initiative could serve as a scalable model for future conservation projects, proving that human engagement is just as critical as ecological functionality in sustaining wildlife populations.

Moving forward, continued testing and refinement will be essential, as well as potential collaborations with milk suppliers to integrate the design directly onto packaging, further expanding accessibility. Ultimately, this project highlights the power of design in bridging the gap between people and nature, demonstrating that conservation efforts can thrive when they are made both meaningful and manageable for the public.

References

- Barrable, A., & Booth, D. (2022, June 30). Disconnected: What Can We Learn from Individuals with Very Low Nature Connection? *International Journal of Environmental Research and Public Health*, 19(13). 10.3390/ijerph19138021
- BBC Gardeners' World Magazine. (2019, July 8). How to make a house martin nest. *Gardenersworld.com*. <https://www.gardenersworld.com/how-to/diy/how-to-make-a-house-martin-nest/>
- Bengtsson, K. (2022, September). Hussvala. Skånes ornitologiska förening. Retrieved October 2, 2024, from <https://skof.se/fagelinresse/artfakta/hussvala/>
- BirdLife International. (2017). Northern House Martin. IUCN Redlist. Retrieved September 30, 2024, from <https://www.iucnredlist.org/species/103811886/118748864#assessment-information>
- BTO. (2016). 14 facts about house martins – The Devon House Martin Project. British Trust for Ornithology. Retrieved October 2, 2024, from <https://devonhousemartins.org.uk/information/house-martin-facts/>
- BTO. (2022). House Martin | BTO. British Trust for Ornithology. Retrieved October 1, 2024, from <https://www.bto.org/understanding-birds/birdfacts/house-martin>
- Burfield, I., & Martin, R. (2021). European Red List of Birds 2021. BirdLife International. Retrieved October 1, 2024, from <https://www.birdlife.org/wp-content/uploads/2022/05/BirdLife-European-Red-List-of-Birds-2021.pdf>
- Felsche, E., Böhnisch, A., Poschlod, B., & Ludwig, R. (2024, July 31). European hot and dry summers are projected to become more frequent and expand northwards. *Communications Earth & Environment*, 5(Article number: 410 (2024)). <https://doi.org/10.1038/s43247-024-01575-5>
- Festinger, L. (1957). *A Theory of Cognitive Dissonance*. Stanford University Press, 291. <https://doi.org/10.1515/9781503620766>
- Frantz, C. M., & Mayer, F. S. (2014, June). The importance of connection to nature in assessing environmental education programs. *Science Direct*, 41, 85-89. <https://doi.org/10.1016/j.stueduc.2013.10.001>
- Haltunnen, K. (2024, July 10). Håller hussvalan på att försvinna som häckfågel i Närke? - Närkes ornitologiska förening. Närkes ornitologiska förening. Retrieved October 1, 2024, from <https://nof.birdlife.se/haller-hussvalan-pa-att-forsvinna-som-hackfagel-i-narke/#>
- Hannah. (n.a). House martin: song, nest & migration - Plantura. *Plantura Magazin*. Retrieved October 2, 2024, from <https://plantura.garden/uk/garden-birds/guides/house-martin>
- Hansson, E. (2021, May 14). Allt färre hussvalor – du kan hjälpa till. *Natursidan*. Retrieved October 1, 2024, from <https://www.natursidan.se/guide/allt-farre-hussvalor-du-kan-hjalpa-till/>
- Heggøy, O. (2016). Taksvale – Årets fugl 2017! *Vår Fuglefauna* 39 (2016), 4.
- Heywood, J., Massimo, D., Balmer, D., Noble, D., Pearce-Higgins, J., White, D., & Gillings, S. (2023). The Breeding Bird Survey 2023 | BTO. British Trust for Ornithology. Retrieved October 1, 2024, from <https://www.bto.org/our-science/publications/breeding-bird-survey-report/breeding-bird-survey-2023>

- Interaction Design Foundation - IxDF. (2016, June 5). What is User Centered Design (UCD)? Interaction Design Foundation - IxDF. https://www.interaction-design.org/literature/topics/user-centered-design?srltid=AfmBOoqQKpT7juOp1yRxXb7iQzcoSMH2booyHGdb7P_lhd0h4du7bgrU
- Kahn Jr., P. H., Ruckert, J. H., & Severson, R. L. (2009, February 1). The Human Relation With Nature and Technological Nature. *Sage Journals*, 18(1). <https://doi.org/10.1111/j.1467-8721.2009.01602.x>
- Kettel, F. E., D. I., Woodward, E. D., Balmer, G. D., & Noble. (2021). Using citizen science to assess drivers of Common House Martin *Delichon urbicum* breeding performance. *Ibis*, 163, 366-379. <https://doi.org/10.1111/ibi.12888>
- Landgeist. (2022, May 3). Milk Consumption in Europe – Landgeist. Landgeist. Retrieved December 27, 2024, from <https://landgeist.com/2022/05/03/milk-consumption-in-europe/>
- Live Science Staff. (2009, April 1). Humans Losing Touch with Nature. Live Science. <https://www.livescience.com/5389-humans-losing-touch-nature.html#>
- Louv, R. (2008). Last Child in the Woods. Algonquin Books. <https://www.childrenandnature.org/about/>
- Norton, M. I., Machon, D., & Ariely, D. (2012, July). The IKEA effect: When labor leads to love. *Science Direct*, 22(3). <https://doi.org/10.1016/j.jcps.2011.08.002>
- Ny Teknik. (2024, July 15). Förvånande upptäckten: "Ingen insektsapokalyps i Sverige". Ny Teknik. Retrieved October 2, 2024, from https://www.nyteknik.se/miljo/forvanande-upptackten-ingen-insektsapokalyps-i-sverige/4276572?utm_source=pocket_shared
- Paterson, B. (2006, February 1). Ethics for Wildlife Conservation: Overcoming the Human–Nature Dualism. *Bioscience*, 56(2), 144 - 150. [https://doi.org/10.1641/0006-3568\(2006\)056\[0144:EFWCOT\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2006)056[0144:EFWCOT]2.0.CO;2)
- Pomroy, J. (2022). House Martin Conservation UK & Ireland. House Martin Conservation. Retrieved October 2, 2024, from <https://housemartinconservation.com/conservation>
- Pomroy, J. (2024, April 26). HOUSE MARTINS 2024. Jonathan Pomroy. Retrieved October 2, 2024, from <https://jonathanpomroy.wordpress.com/house-martins/>
- Pyle, R. M. (2003, April). Nature matrix: reconnecting people and nature. *Oryx*, 37. <https://doi.org/10.1017/S0030605303000383>
- Pyle, R. M., & VanderMaten, J. (n.d.). Tidewater Reach: Field Guide to the Lower Columbia River in Poems and Pictures. Columbia River Reader Press.
- RaddaEnArt. (2021, July 12). Hussvala – minskar i oroande takt. RaddaEnArt. Retrieved October 2, 2024, from <https://www.raddaenart.se/hussvala-minskar-i-oroande-takt/>
- Richardsson, M., Passmore, H.-A., Barbett, L., Lumber, R., Thomas, R., & Hunt, A. (2020, September 3). The green care code: How nature connectedness and simple activities help explain pro-nature conservation behaviours. *People and Nature*, 2(3). <https://doi.org/10.1002/pan3.10117>
- RSPB. (2024). House Martin Bird Facts | Delichon Urbica. RSPB. Retrieved September 30, 2024, from <https://www.rspb.org.uk/birds-and-wildlife/house-martin>

Schenk, A., Hunziker, M., & Kienast, F. (2007, April). Factors influencing the acceptance of nature conservation measures—A qualitative study in Switzerland. *Elsevier*, 83(1), 66-79. <https://doi.org/10.1016/j.jenvman.2006.01.010>

Scissor Skills | NHS GGC. (n.d.). NHSGGC. Retrieved January 5, 2025, from <https://www.nhsggc.org.uk/kids/resources/ot-activityinformation-sheets/scissor-skills/>

Staneva, A., & Burfield, I. (2024). EUROPEAN BIRDS OF CONSERVATION CONCERN. EUROPEAN BIRDS OF CONSERVATION CONCERN Populations, trends and national responsibilities. Retrieved September 30, 2024, from https://www.birdlife.ch/sites/default/files/documents/European_Birds_of_Conservation_Concern.pdf

SUTTIE, J. (2016, September 14). How to Raise an Environmentalist. *Greater Good Magazine*. https://greatergood.berkeley.edu/article/item/how_to_raise_an_environmentalist

Sveriges Lantbruksuniversitet. (2024). Artportalen. SLU Artdatabanken. Retrieved October 1, 2024, from <https://www.artdatabanken.se/artportalen/>

Sylvan, R. (1998). Is there a need for a new, an environmental, ethic? Zimmermann ME, ed. *Environmental Philosophy from Animal Rights to Radical Ecology*. <https://iseethics.wordpress.com/wp-content/uploads/2013/02/routley-richard-is-there-a-need-for-a-new-an-environmental-ethic-original.pdf>

University of Oxford. (2023, May 2). Public is more interested in nature, but not enough to act. University of Oxford. <https://www.ox.ac.uk/news/2023-05-02-public-more-interested-nature-not-enough-act#:~:text=Google%20searches%20reveal%20that%20public,declined%20over%20the%20same%20period.>

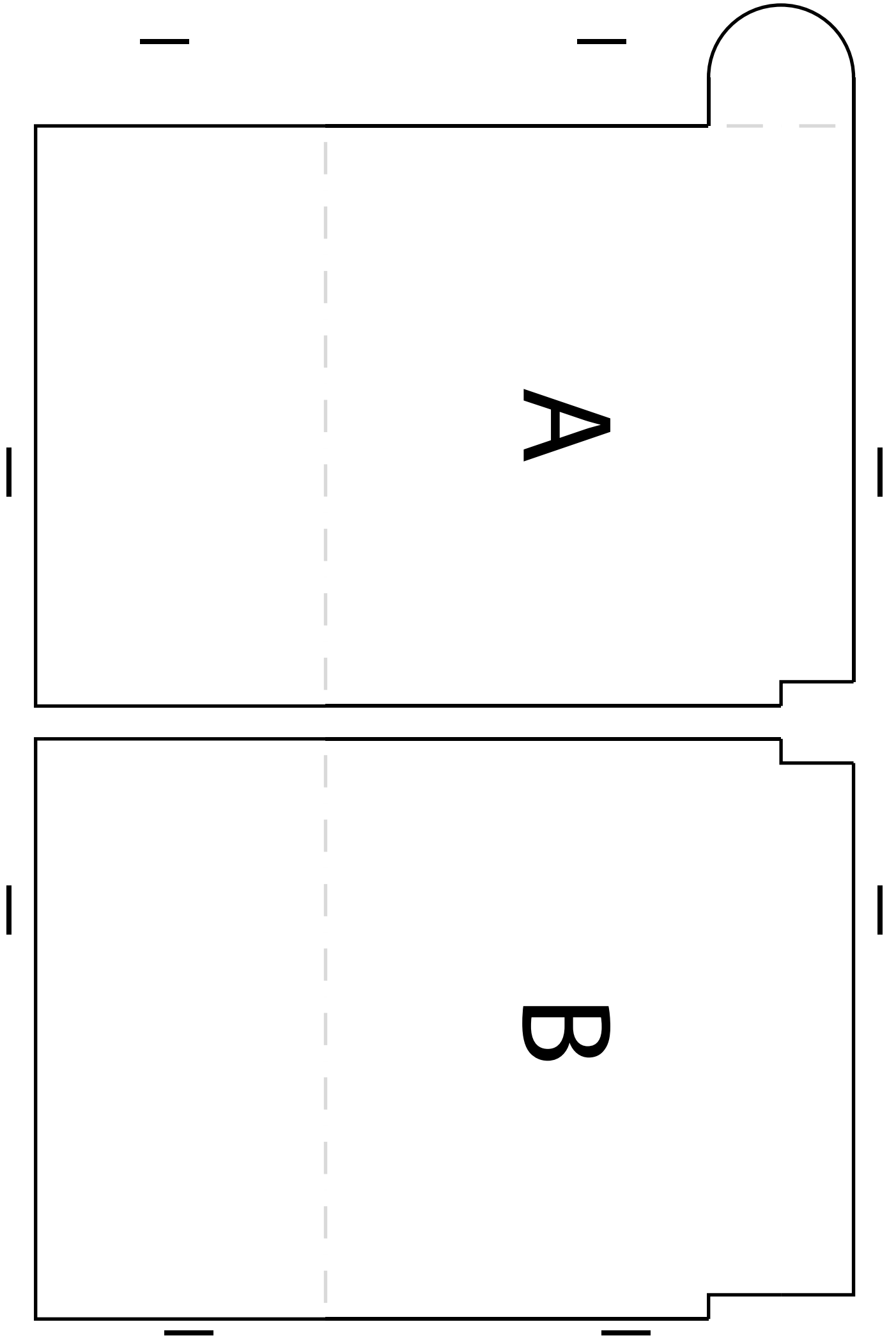
van den Bremer, L., & van Turnhout, C. (2024, April). Does the Provisioning of Artificial Nest Cups and Nesting Structures Help House Martins *Delichon urbicum*? *Ardea*, 112(1), 63. 10.5253/arde.2023.a21

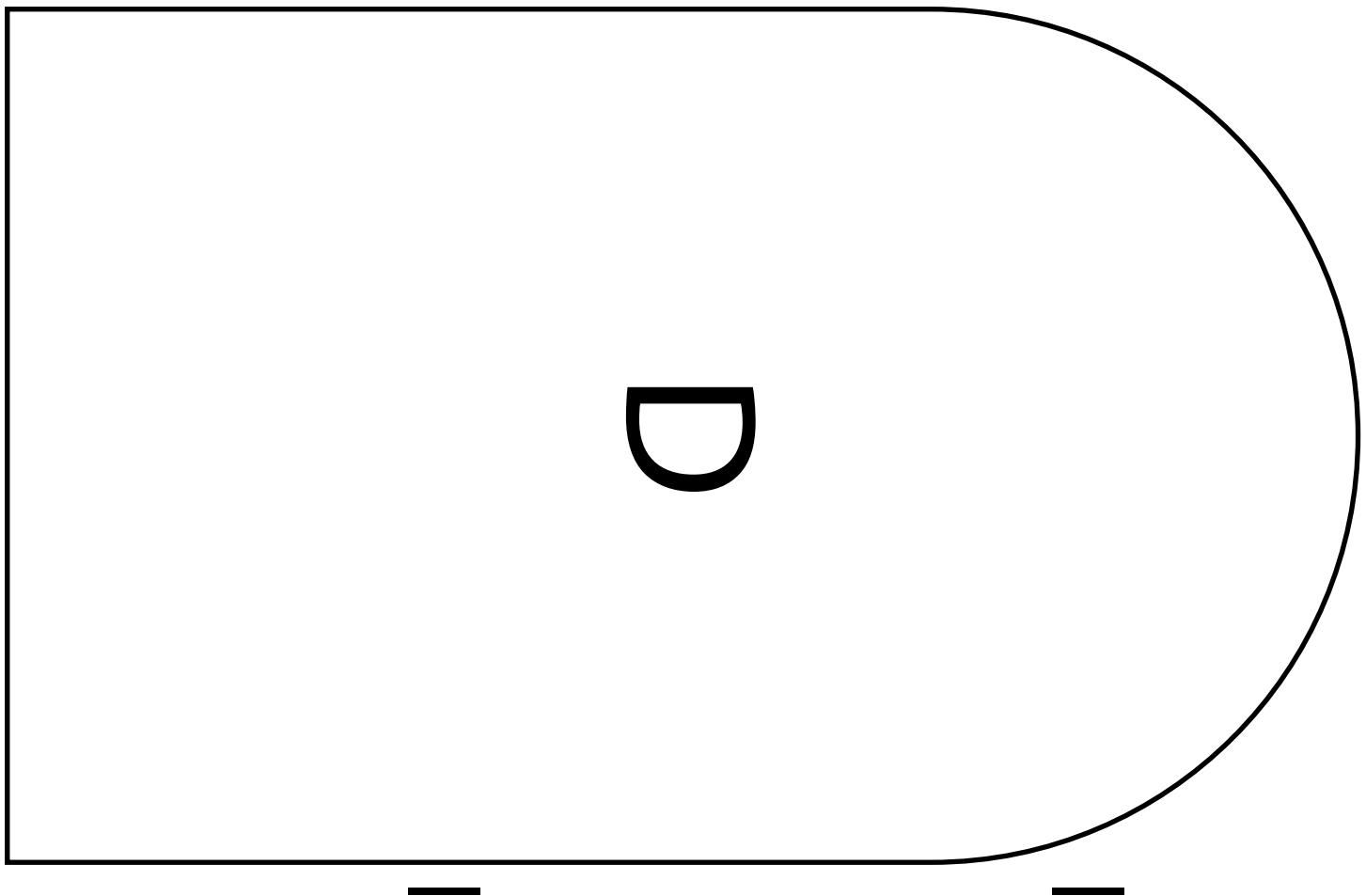
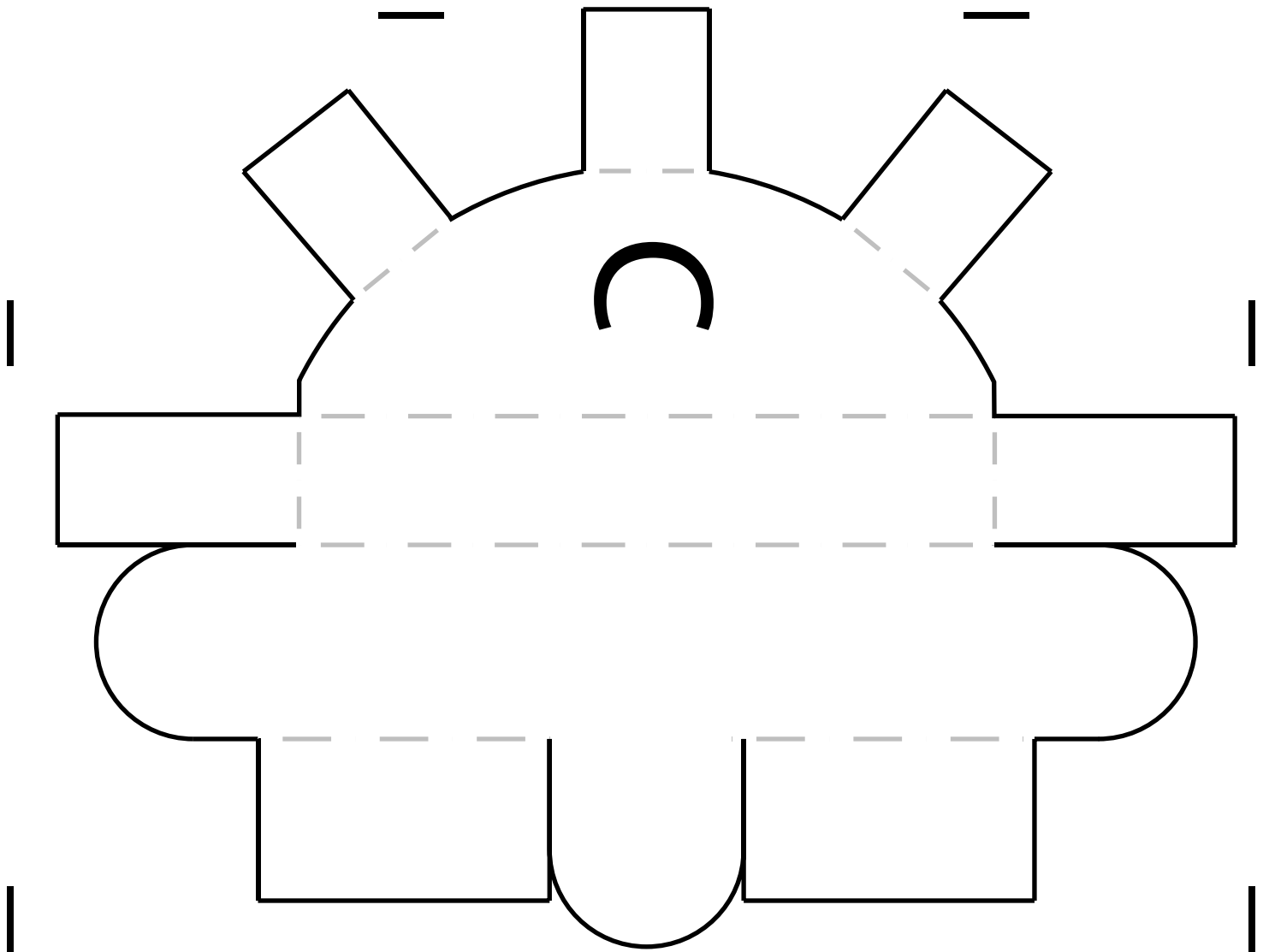
Vine House Farm. (2024). House Martin - Bird Factfile. Vine House Farm. Retrieved September 30, 2024, from <https://www.vinehousefarm.co.uk/birds/house-martin>

Weston, P. (2024, May 16). Swallow, swift and house martin populations have nearly halved, finds UK bird survey. *The Guardian*. Retrieved October 1, 2024, from <https://www.theguardian.com/environment/article/2024/may/16/swallows-swifts-house-martins-decline-uk-bird-survey-aoe>

Wilson, E. O. (1984). *Biophilia*. Harvard University Press.

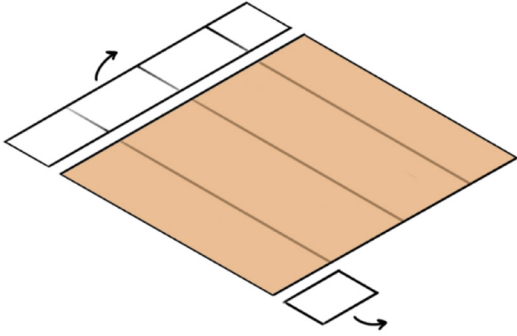
Appendix 1





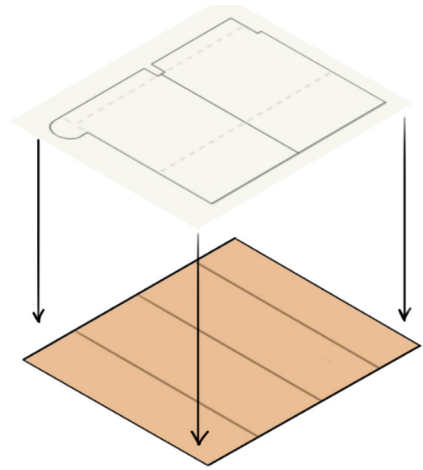
Appendix 2

1.



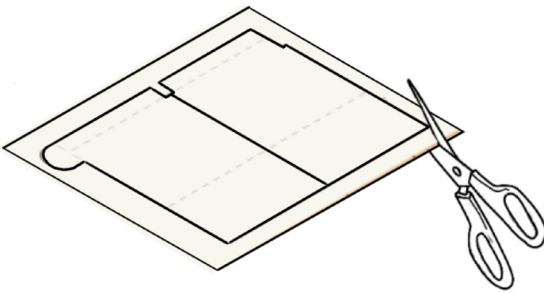
Cut open your milk carton, ideally in the corner where it overlaps, and remove the top and bottom section as shown.

2.



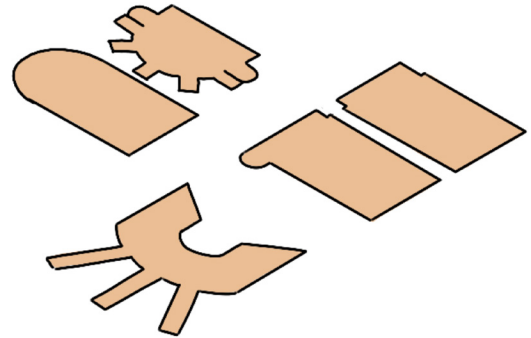
Place the cutout guides on top and staple them where marked.

3.



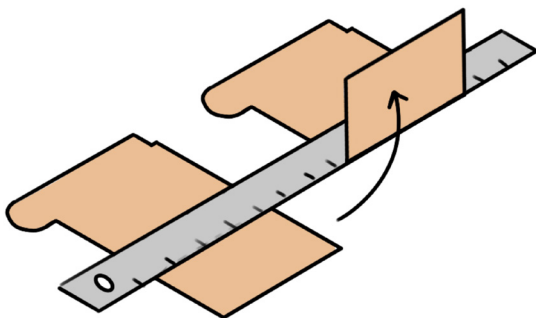
Cut the shapes out as instructed. NOTE, only cut the solid lines, the dashed ones mark where to fold.

4.

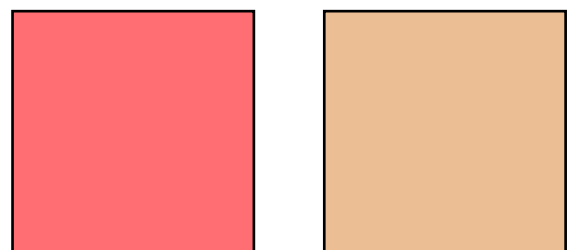


You should be left with these 5 parts.

5.

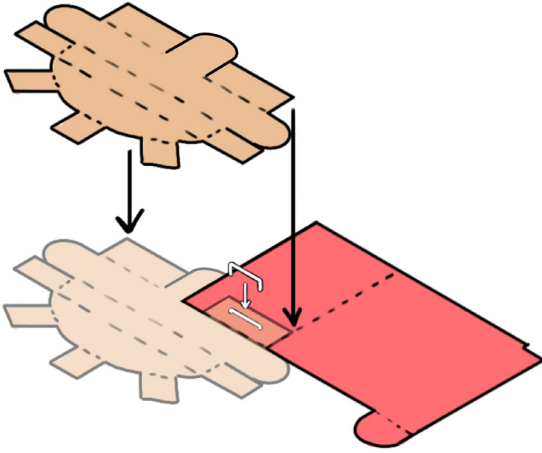


Prepare the fold lines as they are shown in the instructions and fold using a ruler to be precise. The direction of the fold does not matter at this point in time.



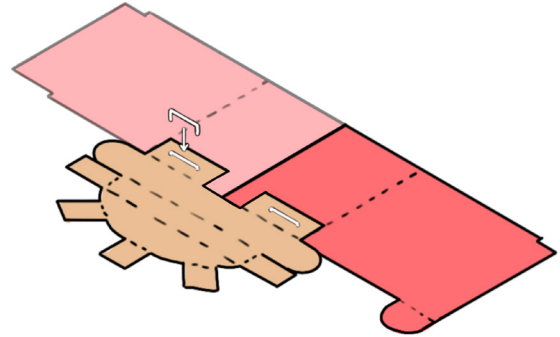
Now you are ready to start building your nest! Note that the red color indicates where the printed side is up, and the brown where the inside of the milk carton is up.

6.



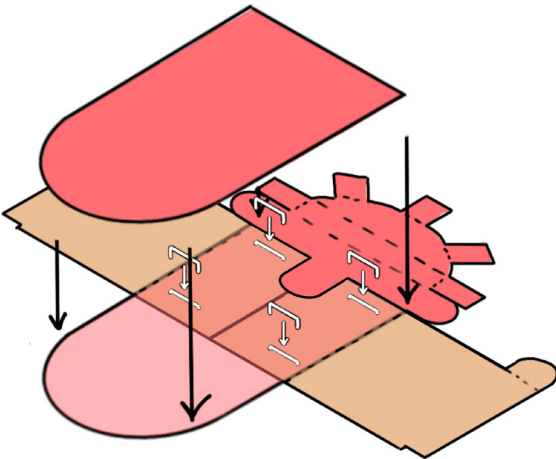
Grab part A lay it with the printed side upwards as shown. Grab part C and place that cardboard side up, making sure to line it up as shown. Staple in place.

7.



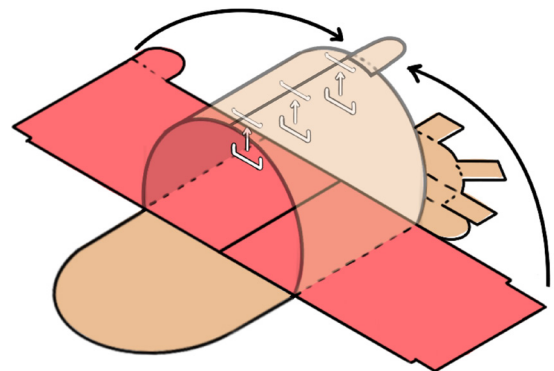
Now grab part B and repeat the process. Make sure to line the folding edges up properly and staple in place.

8.



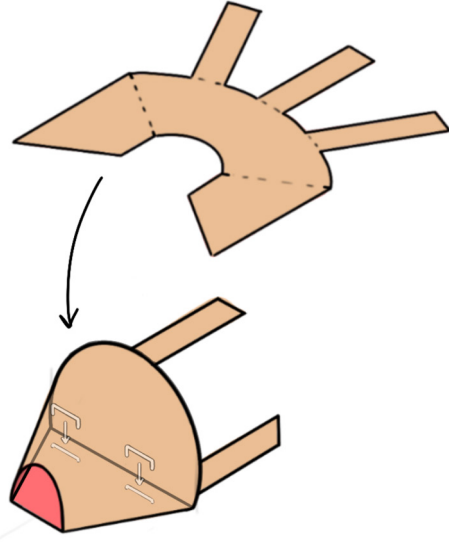
Now flip the stapled part of the nest over and place side D as shown. Make sure to put it underneath side C before stapling stuck.

9.



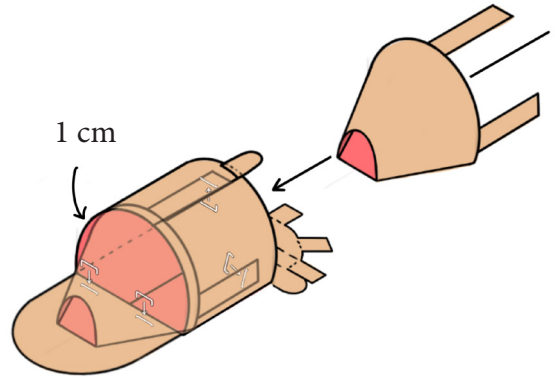
Flip the stapled nest over once again and fold side A and B towards each other as shown. Make sure to overlap the sides so that the cutout on the front side disappears and the cutout on the back lines up with the small flap on part A. Staple in place.

10.



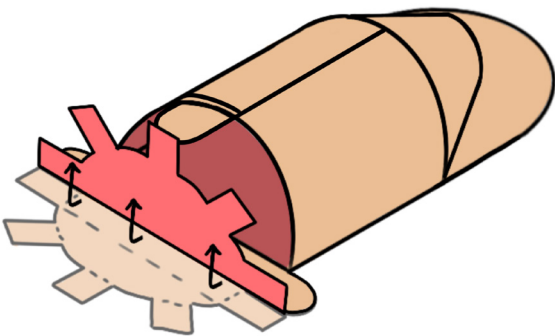
Now grab part E and fold the marked flaps until they overlap. You should end up with the shape as shown. Staple twice in place, from the inside out.

11.



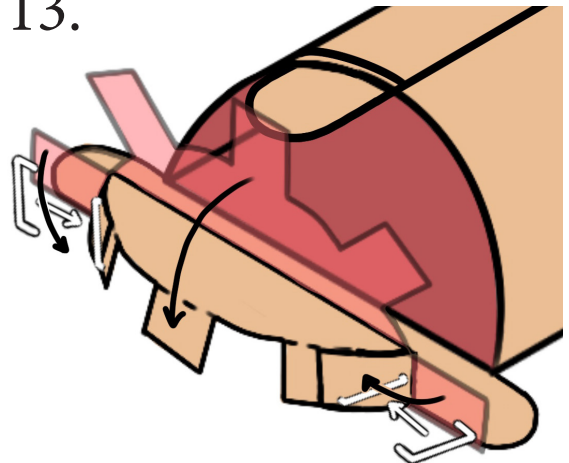
Slide part E in from the back until there is 1cm of edge present at the front. Once in place as shown staple part E first flat in the front by flipping the stapler upside down and through the opening, and then staple the fingers inside.

12.



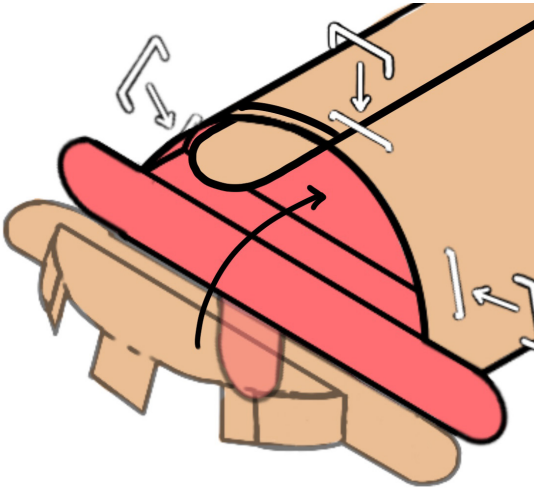
Turn the nest around and flip the backside, part C, up.

13.



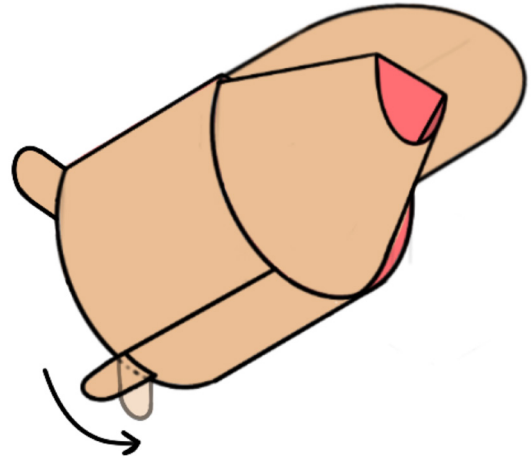
Fold part C now forwards as shown and staple the side flaps onto each other.

14.



Lastly, fold the construction inwards and staple it secure using the three “fingers”.

15.

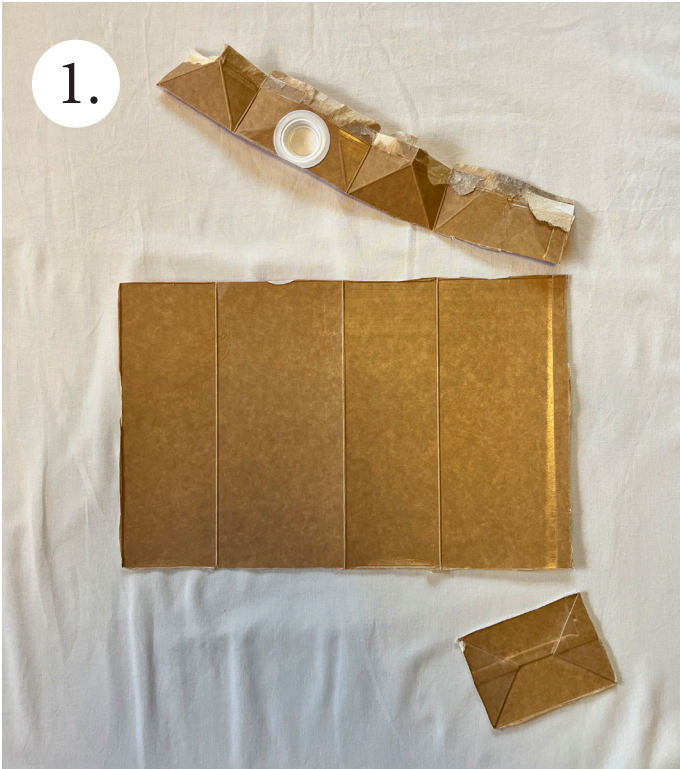


Fold the little flap connected to part A(B?) forwards and the nest is ready to be hung up!



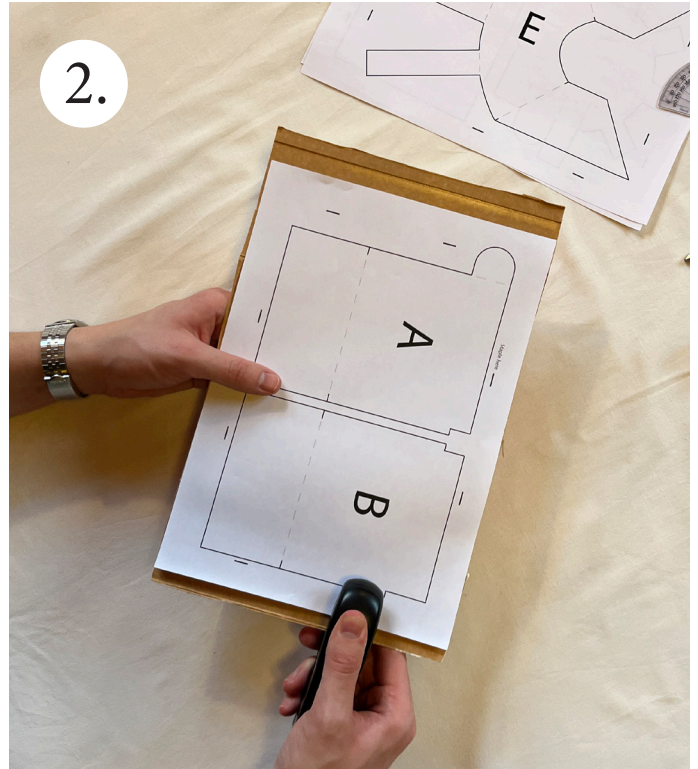
The right place to hang the nest for the Hussvala is right underneath the roof of your home, barn or other structure. It is important that you hang the nests at least 2 meters high and in a position that is not in the full sun throughout the day.

Appendix 3



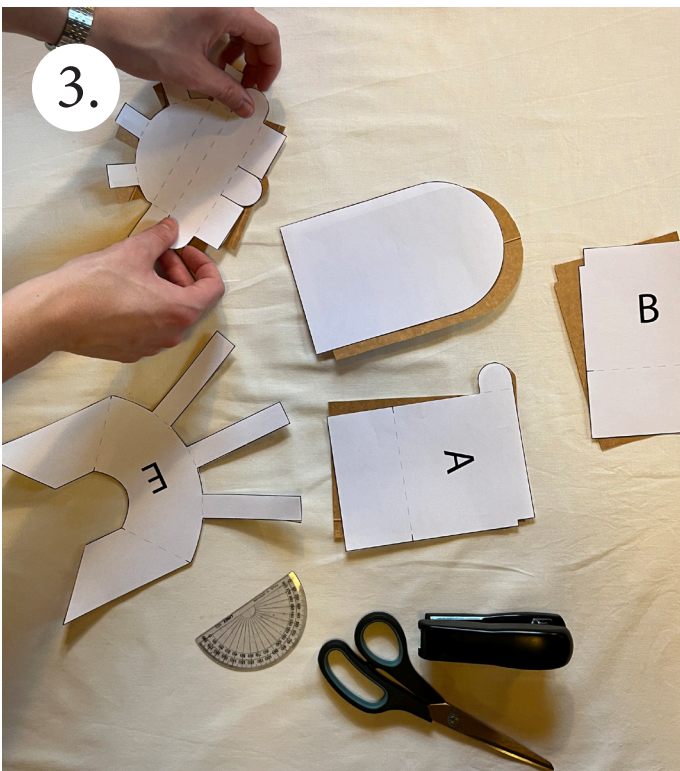
1.

Cut open your milk carton, ideally in the corner where it overlaps, and remove the top and bottom section as shown.



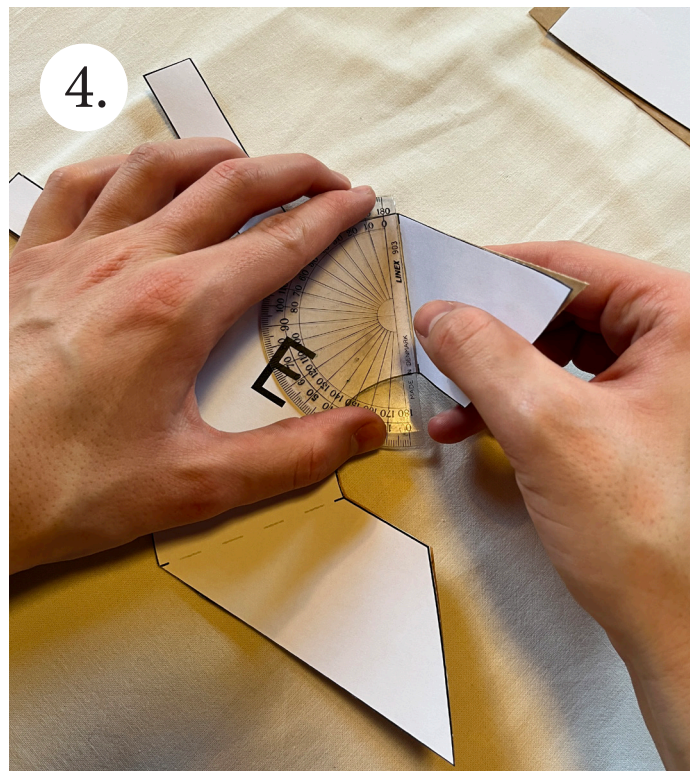
2.

Staple the cutout plans on top of the milk carton sheet and cut along the solid lines. Repeat this for parts A,B,C,D, and E.



3.

With all the parts cut out use the paper cut-out plans to see where to fold. Easiest way is to lay them on top of the carton.



4.

Now fold along the dotted lines with a ruler. This way you can make sure the folds are both in the right place, and sharp.



5. Grab part A lay it with the printed side upwards as shown. Grab part C and place that cardboard side up, making sure to line it up as shown. Staple in place.



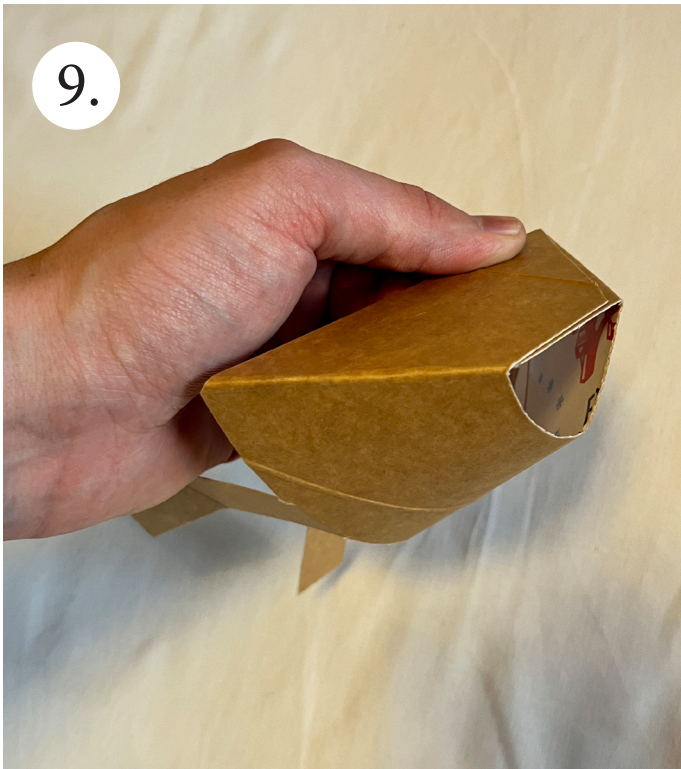
6. Now grab part B and repeat the process. Make sure to line the folding edges up properly and staple in place.



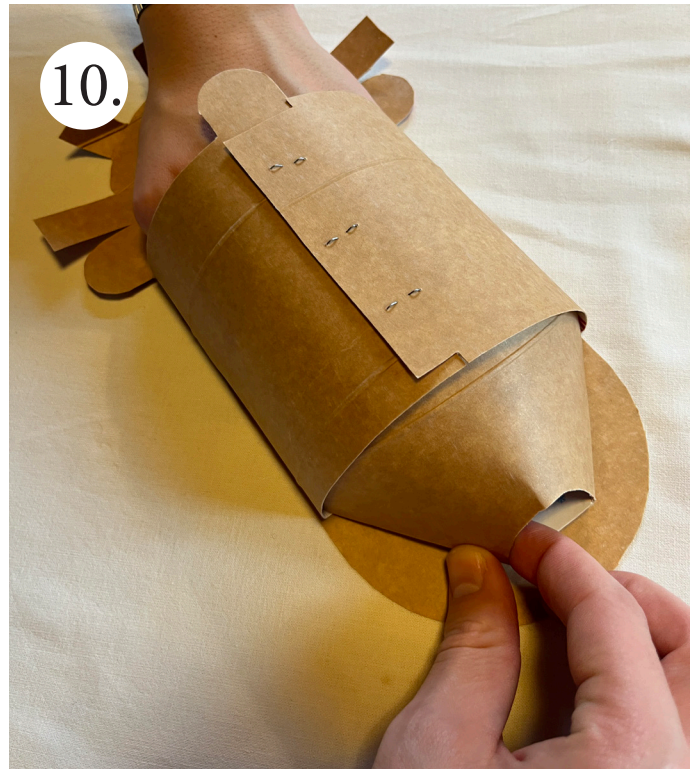
7. Now flip the stapled part of the nest over and place side D as shown. Make sure to put it underneath side C before stapling stuck.



8. Flip the stapled nest over once again and fold side A and B towards each other as shown. Once the cutouts align in the front and with the flap in the back, staple in place.



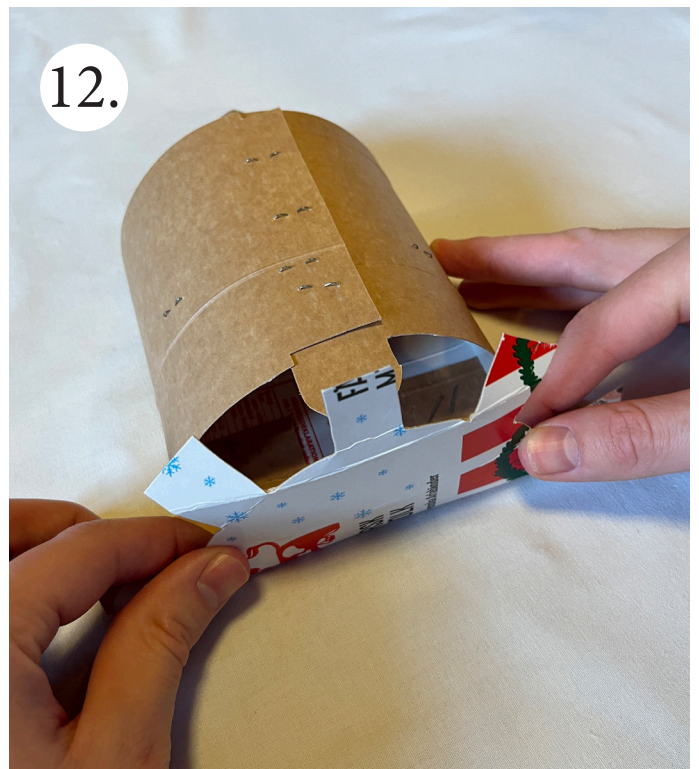
Now grab part E and fold the marked flaps until they overlap. You should end up with the shape as shown. Staple twice in place, from the inside.



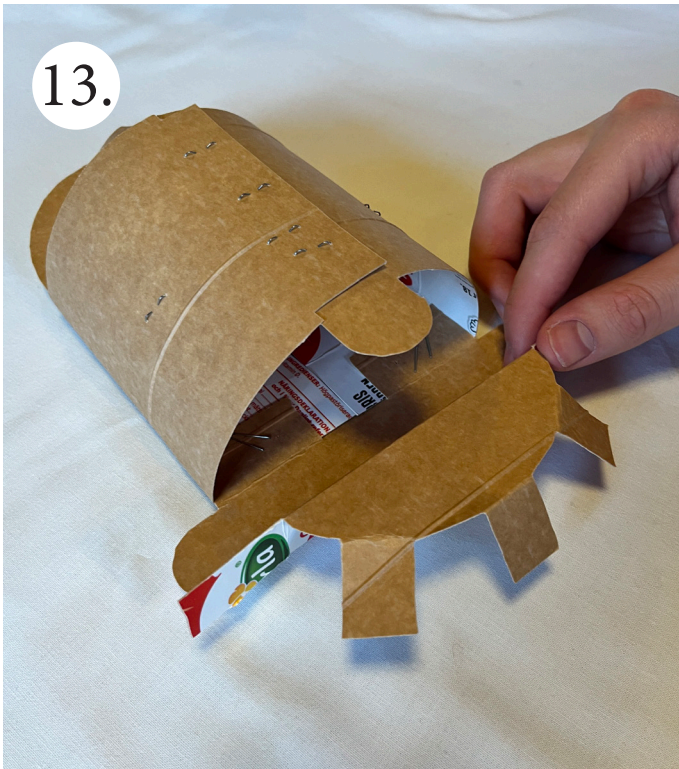
Slide part E in from the back until there is 1cm of edge present at the front. Once in place as shown staple part E as shown in step 11.



The easiest way to staple the front is by going in through the hole with the stapler upside down. Staple hard and when in place staple the fingers in the nest.

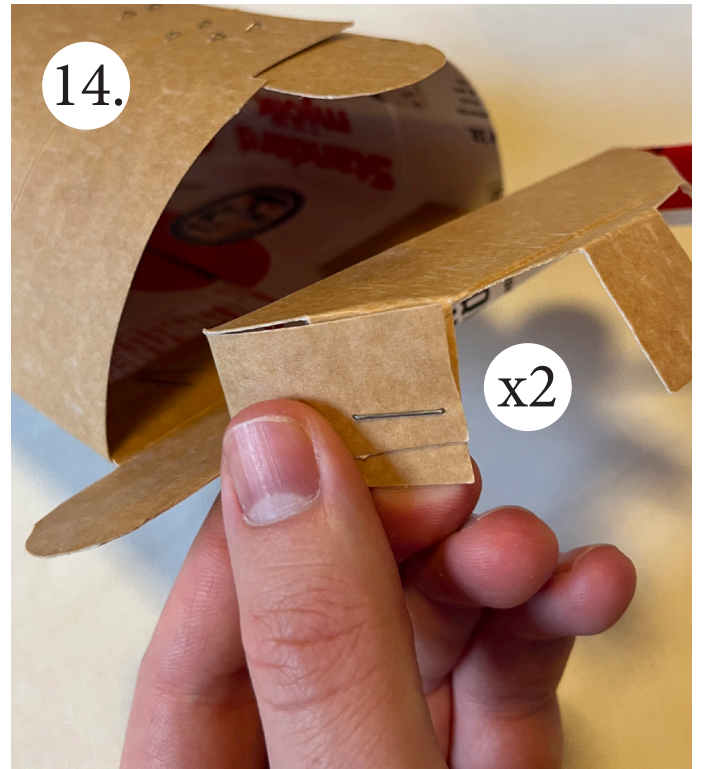


Turn the nest around and fold the backside, part C, up.



13.

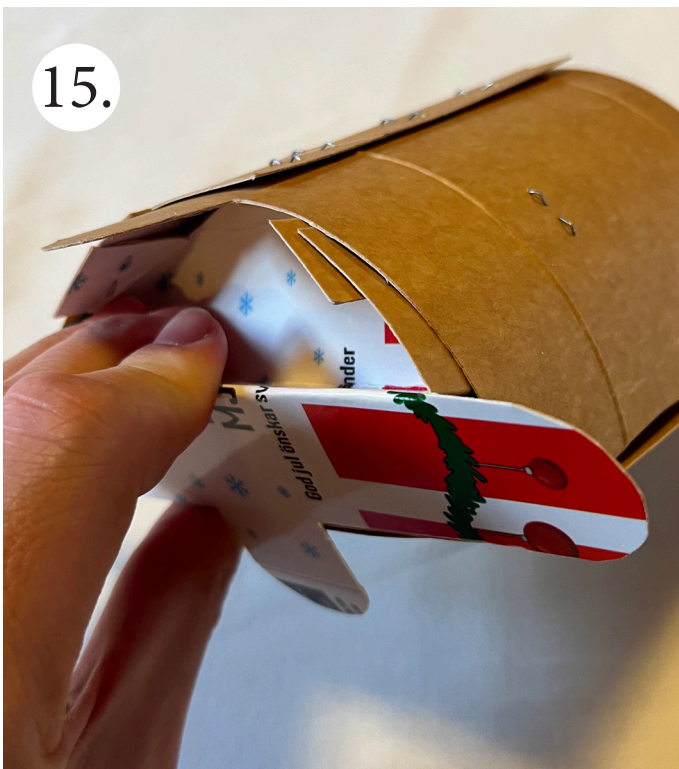
Now fold part C outwards as shown.



14.

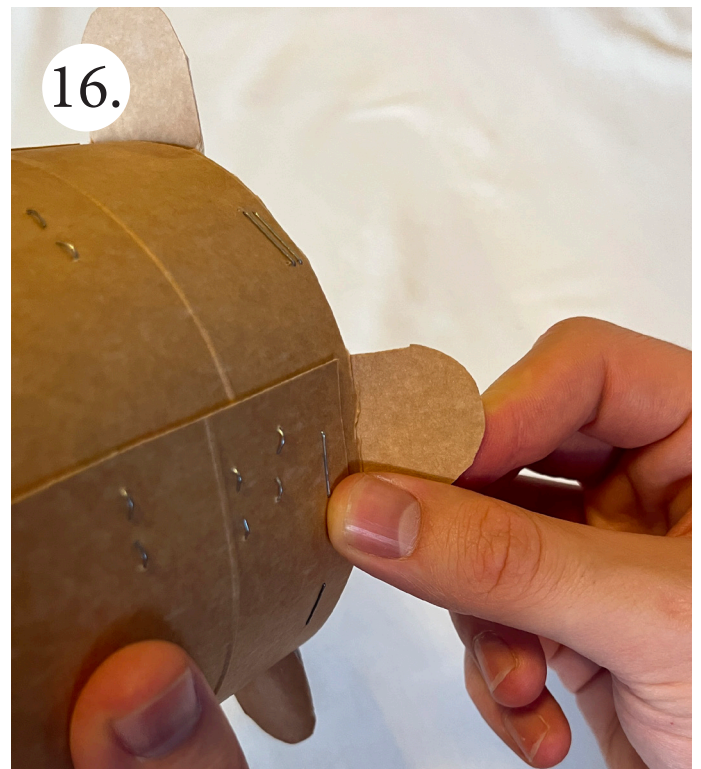
x2

And staple the rectangular flaps on top of each other as shown. Do this for both sides.



15.

Fold part C now inwards into the nest and staple the three flaps in place.



16.

Fold the little flap connected to part A forwards and the nest is ready to be hung up!



Your nest should look something like this!



The right place to hang the nest for the Hussvala is right underneath the roof of your home, barn or other structure. It is important that you hang the nests at least 2 meters high and in a position that is not in the full sun throughout the day.